The NATIONAL GEOGRAPHIC MAGAZINE

Vol. XVIII FEBRUARY, 1907 No. 2

CONTENTS

BEAUTIFUL ECUADOR
By Hon. JOSEPH LEE, U. S. Minister to Ecuador. Illustrated

PERSIA, PAST AND PRESENT. Illustrated

AN ICE-WRAPPED CONTINENT
With 20 illustrations of that great Antarctic Continent—twice the size of Europe—which is covered with mountains of ice and snow

THE BURNING AND BATHING GHATS OF INDIA
By ELIZA RUHAMAH SCIDMORE, Foreign Secretary of the National Geographic Society. Illustrated

HOW LONG WILL OUR COAL RESERVES LAST?
By M. R. CAMPBELL, of the U. S. Geological Survey. Illustrated

POLAR PHOTOGRAPHY
By ANTHONY FIALA

Notes on the Forest Service (Illustrated) and Geographic Literature

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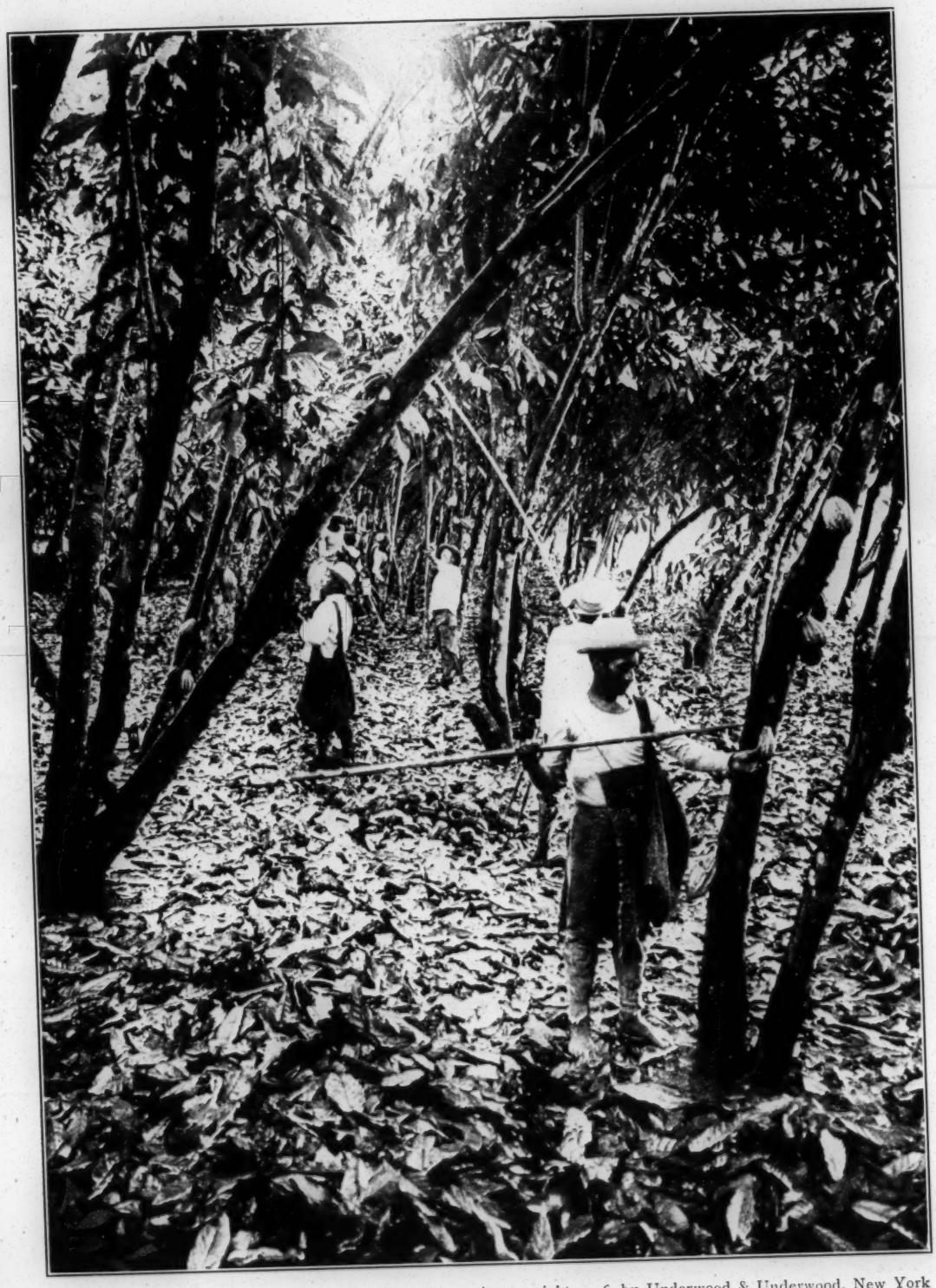

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Gathering Cacao Pods

La Clementina hacienda, Ecuador, the biggest chocolate plantation in the world. The trees are under constant cultivation and are continually growing more prolific. Laborers receive 80 cents to $1.00 (silver) per day, with house-rent free. 200 are employed all the year and 150 additional during harvest season on this plantation.

VOL. XVIII, No. 2 WASHINGTON FEBRUARY, 1907

THE NATIONAL GEOGRAPHIC MAGAZINE

BEAUTIFUL ECUADOR*

BY HON. JOSEPH LEE, U. S. MINISTER TO ECUADOR

THE Republic of Ecuador lies at the northwestern corner of the South American continent, between Colombia and Peru. As its name implies, it is situated upon the Equator.

Ecuador possesses an area of 429,000 square miles, including the Galapagos Archipelago. It is nearly twice the size of France and as large as Texas, New York, Pennsylvania, and Nebraska combined. The population is 1,500,000. Although the country is comprised between one degree north and four degrees south latitude, almost every variation of climate is obtainable, from the torrid lands of the coast to the chilly plains, at an elevation of 12,000 feet, at the foot of the snow-clad peaks of the Andes.

Both the eastern and western ranges of the Andes traverse the Republic. Between these ranges lie extensive high valleys yielding the products of the Temperate Zone. To the west of the Cordillera stretch the low tropical lands on the Pacific, and to the east the country gradually descends to the low Amazon Valley and the frontiers of Brazil.

Guayaquil, the principal seaport of the Republic, is situated on the River Guayas, the most important stream in South America emptying into the Pacific, about sixty miles above its mouth. It has a population of 50,000. It is the emporium of Ecuador. All imports and exports pass through Guayaquil. The houses are built of wood, owing to the lack of other material. They are constructed in the southern style, with balconies protruding over the sidewalks and resting upon wooden pillars, thus forming piazzas which afford protection against sun and rain. As fires under the circumstances are particularly dangerous, Guayaquil has perhaps a more extensive fire department than any city of its size, and ample reservoirs of water on a hill behind the town. It is improbable that Guayaquil will ever again be visited by such disastrous conflagrations as in the past.

GUAYAQUIL

The hospitals of Guayaquil are as complete as any in South America. The great new General Hospital, with its modern appliances, compares most favorably with Ancon Hospital at Panama. Although the cathedral, the churches, the great municipal buildings, and theaters are built of wood, they are imposing and are decorated in perfect taste. The Union Club of Guayaquil is, with

*An address to the National Geographic Society November 30, 1906.

the exception of the Hongkong Club, the best I have ever seen in the tropics. Under the bright light of the moon, these buildings appear to be constructed of rare marbles. The public squares are beautifully kept and filled with rare specimens of the rich vegetation of Ecuador.

The harbor is always busy with shipping. Two steamers each week sail for Panama and two arrive from the Isthmus. Fleets of tugboats, lighters, canoes, and balsas cover the water. The canoes, laden deep with fruit and country produce, come down river on the swift tide and return on the turn of the tide with scarcely the necessity of moving a paddle. The balsas are used to a great extent. They are a maritime contrivance invented by the ancient Peruvians and made of five, seven, and nine trunks of an exceedingly light tree called balsa, in sizes as required. Large balsas go with safety to sea as far as Paita, in Peru. The logs are lasned together with vines, and are fastened so firmly that they can ride almost any sea. The whole structure adapts itself to the waves, and no water rises between the logs. Houses are generally built upon them and form homes for a literally "floating population."

The dry season lasts from June to December. The weather is very pleasant and the nights and mornings are often cold. The mean temperature of Guayaquil is about 78 degrees.

On clear summer days, Chimborazo may be seen, rising 21,000 feet above the long chain of the Cordillera, covered with ice and snow whose dazzling whiteness is intersected by black lines formed by the sharp edges of frightful rocks upon which the snow cannot gather.

Guayaquil exports one-third of the world's supply of cocoa. It is raised along the Guayas River and its tributaries and is the principal staple of Guayaquil. Ivory nuts, from which bone buttons of commerce are made, are exported in enormous quantities. Panama hats, so called because they are distributed to the United States and Europe by way of the Isthmus of Panama, are manufactured in the Province of Manabi. The lowlands of the coast also produce cinchona bark, from which we obtain quinine (Countess of Chinchon), rice, coffee, sugar, tobacco, rubber, copal gum, vanilla, sarsaparilla, salt, petroleum, and cotton. It is interesting to note that during our civil war England was supplied with cotton from Ecuador. Of course, every variety of tropical fruit is produced and fine timber for house and ship building.

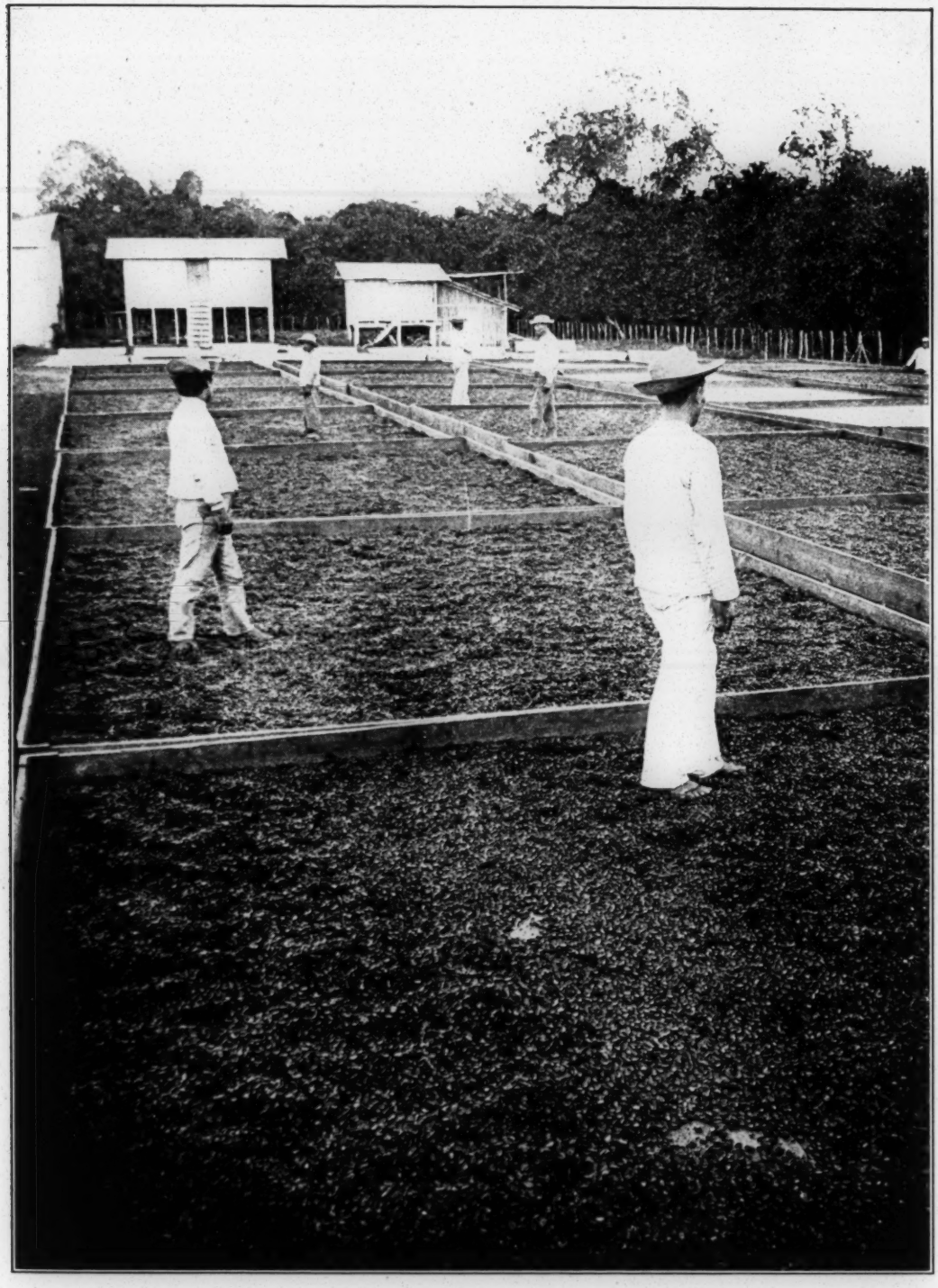
The daily papers of Guayaquil, *The Nacion, Telegrafo, Grito del Pueblo,* and *Tiempo,* are well patronized, well published, and of much influence. A satisfactory daily telegraphic service is maintained with the rest of the world. It is to be regretted that our newspapers do not devote an equivalent amount of space to events in South America.

Across the river from Guayaquil is Duran, the terminus of the Guayaquil and Quito Railroad, a company incorporated under the laws of the State of New Jersey. This railroad, built by American engineers, is completed for a distance of 140 miles and rises to a height of 12,000 feet, under the shadow of Chimborazo. The road bed is leveled into the city of Quito, 260 miles from the coast, and track is being laid at the present time at the rate of a mile per day.

ASCENDING THE ANDES

Leaving Duran at 7 a. m., the train proceeds over flat and gently rising country to the foothills of the Andes. In the level country are the great sugar estates, stretching for miles on either side of the track and equipped with lines of miniature railway for hauling cane and with large sugar factories. Leaving the plains, the ascent is gradual through dense tropical forests plentifully watered by streams and cascades which can supply unlimited water power.

At an elevation of from 4,000 to 5,000 feet there rises a mass of colossal, bald, rounded hills, almost shutting out the sunlight, and it appears impossible that the railroad can proceed further. The



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Drying Cacao Beans in the Sun

La Clementina plantation, Ecuador, where 25,000 pounds are produced yearly for American and European chocolate factories. When the pods are first opened the beans and enveloping pulp are creamy white, but they grow brown by exposure to sun and air. The beans shown here are spread on bamboo matting. The workmen rake them over once in a while by scuffling through them with bare feet to ensure even drying. The trees in the distance are cacao trees, of which there are 3,000 acres in this one estate.

mountains seem an unsurmountable wall 9,000 or 10,000 feet high. But American engineers have found a way and have accomplished one of the most difficult feats known in railroad construction. A sugar-loaf peak stands out in front of the towering hills. Cut zigzag in the sheer face of the granite, a switchback of four levels has solved the problem of rising to 9,000 feet. This level attained, the line advances through volcanic country, seamed with ravines and surrounded by sulphur-covered hills, until a similar cul-de-sac is reached. This in turn is surmounted by means of a similar switchback loop with a grade of 7 per cent, and we reach the Pass of Palmyra, on the roof of the world, at 12,000 feet. Wild wastes of shifting sand surround the track. Stiff grass, like rushes on the sea-shore, is the only vegetation. Fossil shells are found here, and the general appearance of the country is that of the sea-coast.

From this point there is a gradual descent until the present end of the road is reached at Cajabamba, 11,000 feet above the level of the sea and at the foot of mighty Chimborazo. At this place there are some of the few existing remains of buildings erected by the ancient Incas. They are built of great masses of stone fastened together with cement. The stone can be broken, but it is impossible to make any impression upon the cement. Strange to relate, I found living here a former Rough Rider, whom I had known in Cuba. He is engaged in the purchase of hides for the New York market.

It is necessary to spend the night in this village and to set out for Quito early next morning by automobile or diligence. I have always found it more satisfactory to travel by diligence. In this way baggage can accompany the traveler and a long wait at the journey's end is avoided.

The wagons are drawn by teams of five or six miles. Sixty mules, with changes, are used to reach Quito. Two drivers occupy the box seat, one furnished with a long-handled whip for the leaders, the other with a short whip for the wheelers. The animals are urged on with whistles and shouts without intermission. It is the most thrilling, exciting, and hair-raising locomotion I know. The mules are kept at full gallop down the long slopes of the Andes. It is often as much as they can do to keep ahead of the coach. However, I never heard of an accident. The drivers are men long trained in the business and do not know what fear is.

Formerly, before the days of the railroad and carriage road, it took ten days on mule back from Guayaquil to Quito; now by rail and coach the time is three days. I have made the journey with automobile and train in 20 hours.

A LAND MADE FOR GIANTS

The country is on a colossal scale. It seems a land made for giants. High in the air, the tops of the rounded hills are one patchwork of cultivated fields. At the foot of the hills lie smiling green valleys. There is abundant water and the dry places are well irrigated. Along the roadside water is carried for long distances by means of tunnels cut in the volcanic soil, with arched openings at certain intervals. The scarlet wool ponchos worn by the Indian laborers make it possible to pick them out, in the marvelous clear atmosphere, on the hills and in the valleys at surprising distances.

It is necessary to spend the night at the city of Ambato (8,000 feet). The town lies in a deep cauldron. The climate is delightful. Here apples, plums, and peaches flourish as well as the vegetables and cereals of the Temperate Zone. Ambato has several cotton mills, producing the coarse white cotton cloth universally used by the Indians for shirts and wide baggy trousers. Water power is abundant and the mills pay well. Ambato is also the headquarters for the trade from the Oriente, or the lowlands towards the east stretching to the valley of the Amazon. A line for a railroad to tap this district, rich in rubber and gold, has been surveyed and work will begin soon.

Leaving Ambato in the early morning, we can see one of the most glorious

sights of the world—sunrise on Chimborazo. The majestic giant stands out in the dawn, his mantle of snow washed with crimson and gold. The road winds over gigantic hills, around precipices, and down steep descents until we reach the great plain of Latacunga, stretching to the foot of dread Cotopaxi.

The fields as well as the broad roads crossing the wide valleys are inclosed by adobe walls surmounted by the broad-leaved American aloe. The aloe, sometimes called the century plant, is one of the most useful and important plants in the country. It is an erroneous idea that it flowers only once in a hundred years. The Indians thatch their huts with its leaves. The leaves when tapped yield syrup; they can also be used as soap, and the spines as pins. The fiber is woven into sacks and from it are made the coarse sandals worn by the common people. The tall flower stalks are used for beams and ladders. The flowers, boiled and soaked in vinegar, make an agreeable pickle.

The cochineal is found in abundance upon the leaves of the plentiful cactus. Its name is derived from its supposed resemblance to a little pig (cochinillo). It is used by the Indians for dyeing ponchos and shawls.

As we approach the city of Latacunga the country becomes more sterile. The plain is covered with volcanic sand and pumicestone, indicating the neighborhood of Cotopaxi. The houses and churches are built of pumicestone thrown out by the mountain, which in the past has caused much destruction to this part of the country.

There is a legend that the great earthquake of 1698 was predicted by a priest seven years before it took place. The Carmelite nuns of Latacunga believed in the prophecy and slept in tents in their garden for seven years. The convent fell, but the nuns were saved.

Latacunga is the starting point of the most romantic gold legend in Ecuador. The lost treasure of the Incas is supposed to be hidden in the neighboring hills. One Valverde, a Spaniard, was informed of the secret by his sweetheart, an Inca maiden, and he became suddenly very rich. He left a description and guide of the hiding place. This document was preserved in the archives of the city until it was stolen. Many expeditions have been made in search of the lost treasure, but without success.

From this city we journey over rolling country to the foot of Cotopaxi (18,890

Water Carrier

feet). The mountain presents a beautiful appearance, clad in its robe of snow. Its shape is that of a regular truncated cone with a flat summit. The crater is uninterrupted in activity, and volumes of white and gray smoke continually issue from it. Generally the smoke assumes the form of an enormous tree, with trunk and branches, until a current of air tears it away from the mountain and it floats

Making Sun-baked Bricks in the Andes

away a cloud, while by night the smoke forms a pillar of fire. Near the snow-line is a huge mass of rock called the Inca's head. According to legend, this was the original summit of the mountain, torn off and hurled down by an eruption on the day the Inca, Atahualpa, was executed by the Viceroy of Peru.

After crossing the high pass of Chasqui, above the clouds, the road lies through rich pastures and fertile fields. The green pastures of the beautiful valley of Machachi spread around us, dotted with countless herds of cattle and horses. Beautiful villas set in gardens and groups of trees nestle at the foot of great hills.

Houses are closer together as we near Quito, the capital. Numberless Indians, men and women, carrying burdens or driving laden mules, form an endless procession. For the entire length of the great Ecuadorian highway, human beings are always in sight.

The Indians carry everything on their backs. The load is supported by a strap passing across the forehead. Their strength lies in the muscles of the neck, not in their arms. Their gait is a dog trot, which they can keep up all day. They are very polite and submissive.

A SNOW-WHITE CITY

Quito is built in a bowl-shaped valley, at the foot of Mount Pichincha. The altitude of the city is 9,600 feet above the sea. The mountain rises in the background to a height of 16,000 feet. The view which presents itself from the summit of this mountain is one of the most superb and imposing possible to conceive. Twenty snow-clad peaks rise before you, ranging from 15,000 to 22,000 feet. It is truly a Council of the Patriarchs of the Andes.

There are three entrances to the city—two from the south and one from the north. We enter from the south by a picturesque bridge spanning the Machangara River.

The direct rays of the equatorial sun are white as lime-light, and the first impression of Quito is that of a snow-white city, relieved by roofs of rich red tiles. In the streets and plazas are thousands of people, continually moving. The majority are Indians in scarlet or orange ponchos, wide white cotton trousers, and broad-brimmed white felt hats. There are Indians from a hundred different villages, marked by the cut of the hair, the turn of a hat, or the shape of a poncho. The streets are thronged from morning to evening with mules, horses, oxen, donkeys, and llamas with loads of every description.

Ladies in smart victorias, drawn by Chilian or native horses, drive to and from the shops filled with merchandise from Paris, New York, London, Vienna, and Berlin. Handsome officers in full regimentals stroll along the streets. Gentlemen in frock coats and top-hats are everywhere.

The city is traversed from east to west by two deep ravines, through which Pichincha sends down its torrents of melted snow. The land upon which the city is built is, in shape, like the inside of an oval bowl, at the bottom of which is the Plaza Mayor. The course of the streets is generally regular, running east and west and north and south. The streets are paved with cobbles. The houses, of stone and brick, are mostly built in the Spanish-Moorish style, with courtyards within. The roofs project over the sidewalk and afford protection from rain. Balconies overhang the streets from every window. The ground floor on the street has no connection with the rest of the house and is usually occupied by shops. The entrance is always high enough to admit a mounted horseman with ease. Around the courtyards are galleries, supported by arches or pillars. The living rooms open upon these galleries. Servants are cheap and faithful.

There are several good hotels in Quito—the Royal Palace, Hotel de Paris, Hotel Americano, and the Casa Azul.

The people of Quito are charming, courteous, and hospitable. I do not know any city of its size which contains as

many intelligent and cultivated people. Their hospitality is proverbial. I have continually received presents of sweetmeats, butter, cakes, venison, and even fish. There are no fish in or near Quito. They must be brought from Guayaquil frozen in blocks of ice—a journey of six days on mule back. I shall always be indebted to my courteous, cultivated friends of Quito for their constant kindness to me.

The population of Quito is computed to be about 70,000. Being the capital of the Republic, the government buildings and offices are here and also the presidential palace. The handsome government and municipal buildings, the bishop's palace, and the cathedral surround the great plaza. There are many beautiful churches and convents in Quito. The church of the Jesuits is superb, with its interior a mass of scarlet and real gold. Singers from Europe are attached to the choir. Here in the capital, above the clouds, is one of the prettiest theaters in South America.

The *Commercio* and *Tiempo*, the leading newspapers, are progressive, well edited, and influential.

The mean temperature of the city is about 60 degrees. The thermometer scarcely ever rises above 70 degrees or sinks below 50. The mornings and evenings are cool, the middle of the day warm. The climate is delightful—never hot, never cold—a perpetual early spring. Consumption and pulmonary diseases are practically unknown. Many marvelous cures have been accomplished in cases of consumption where hope had been given up. There are many people who would pay any price to be delivered from the great white plague. Quito seems to be a cure. The days and nights are of twelve hours' duration the year round. The difference between sun and shade is 10 degrees. This difference is felt at once by moving from sun to shade or *vice versa*. A journey of four hours from the city will place the traveler in the region of eternal frost, or in the space of half a day he can descend to the deep and sultry valleys which separate the mighty chains of the Andes. This variation of temperature, depending upon elevation and occurring between narrow limits, furnishes a daily and diversified supply of vegetable food, from the banana, pineapple, orange, and plantain, to wheat, corn, potatoes, cabbages, salads, apples, pears, grapes, and strawberries. Hens lay so persistently that medicine has to be given to them to save their lives. As the climate is cool and the houses unheated, daily and frequent exercise on foot or on horseback is absolutely necessary. On leaving the city it is difficult to avoid the sun, as trees are scarce; but sunstroke is unknown. Mosquitoes, snakes, scorpions, tarantulas, and rats are unheard of. There are no bugs or beetles.

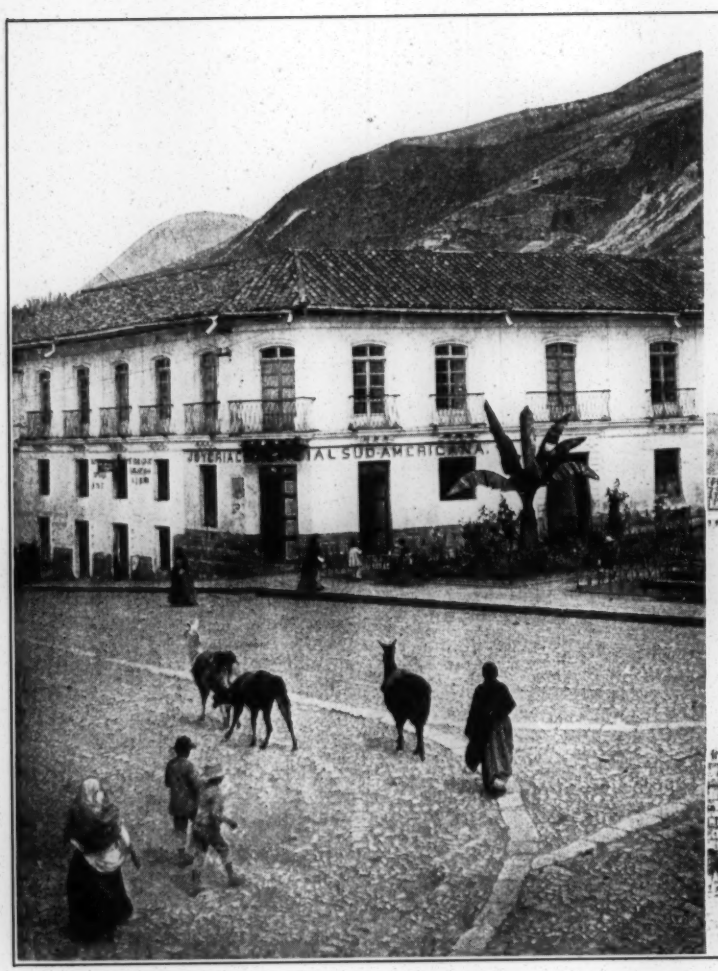
The flora of Quito is beautiful and inexhaustible. Roses bloom all the year round; wild flowers cover the sides of courtyards and ruins; tulips, orchids, pinks, and lilies bloom winter and summer, and geraniums run riot over walls and roofs.

COMMERCIAL PROSPECTS

Ecuador is a sound-money country and has never issued paper money. As the Ecuadorians have demonstrated in the past their good sense in this matter, the actual currency, which is on a gold basis, is unlikely to be disturbed in the future.

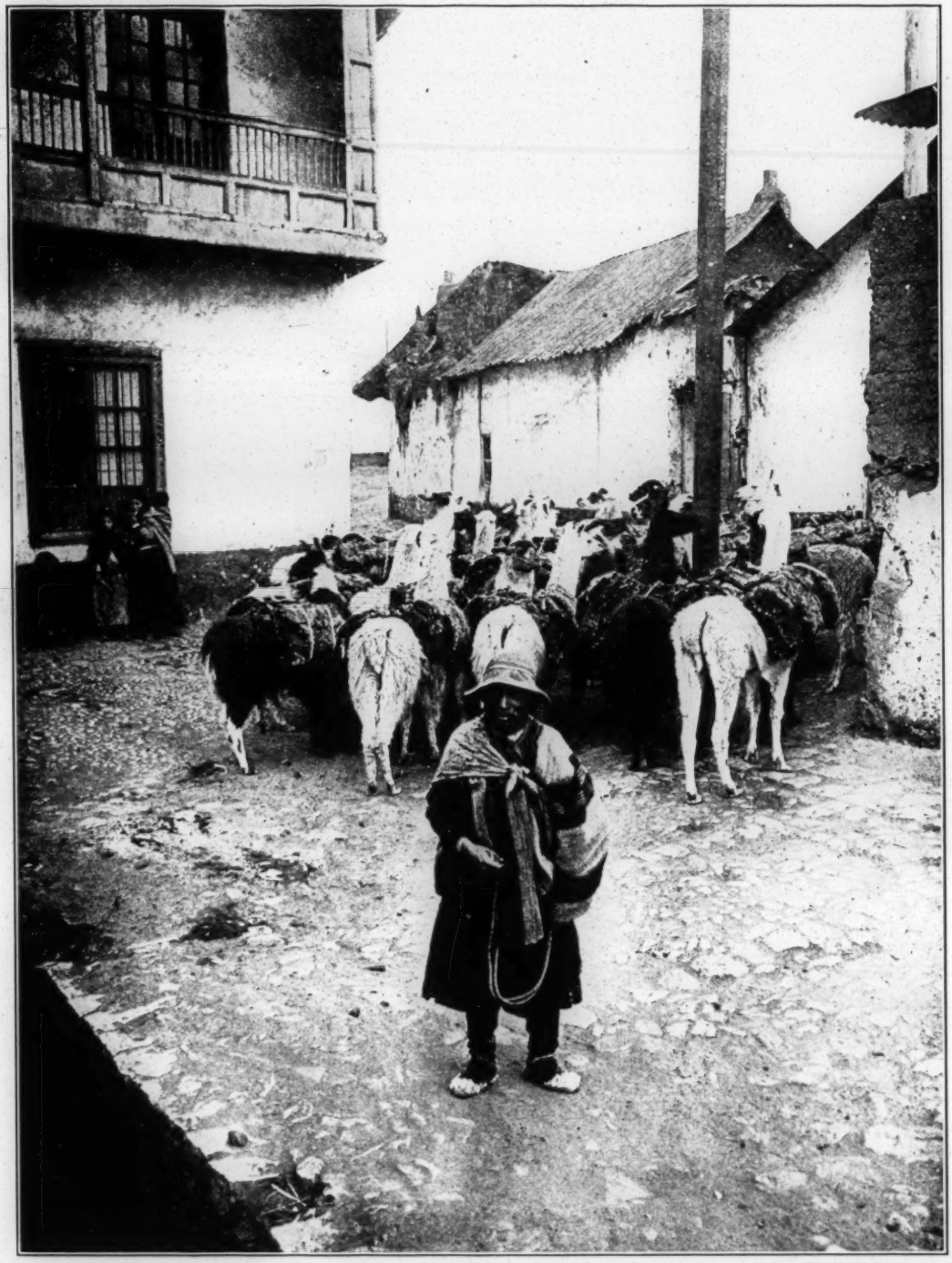
Ecuador has no foreign debt. The only foreign debt incurred has been paid off. This was the money borrowed during the struggle for independence. The only obligation of the government at present is the interest on the bonds issued for the construction of the Guayaquil and Quito Railroad. Development always follows the railroad.

Ecuador is the principal producer of cocoa and ivory nuts in the world. On the coast, coffee, rubber, bananas, sugarcane, rice, cotton, and tobacco grow luxuriantly. Upon the plateaux of the high districts are produced wheat, corn, oats, beans, potatoes, and all the principal



Street Scene in Quito

The San Francisco Cathedral, Quito



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Llamas and Their Driver, a Native Indian of Inca Descent

These tough little beasts are akin to the Arabian camel and are used commonly for beasts of burden on rough mountain roads in the Andes. They can carry 100 pounds apiece and travel nearly all day, picking up their food as they go along in the form of wayside grass, twigs, etc.

cereals of the Temperate Zone. This section also supplies cattle, horses, sheep, and pigs. There is abundant pasture all the year. It is an agricultural country.

The establishment of industries is welcomed. The rivers on the coast and the streams in the mountains furnish ample and cheap water power. Some of the industries which would give results are banana planting on the coast, where land and labor are cheap, the crop finding a ready market; lard-refining, as immense quantities are imported by way of Panama and Cape Horn to supply Ecuador, Peru, and Chile; cotton and woolen mills for the same markets; cement works to supply public construction and railroad building; furniture factories, china and glass works, distilleries, and canning and preserving factories—all these industries would find the necessary elements, raw material of the best quality, and cheap labor. For cement the country provides all the materials; also for china and glassware; for shoes, fine leather and hides; for furniture, a great variety of useful and precious woods. There is enough land on the coast available to supply the banana market of the world. The fisheries around the Galapagos Islands, which belong to Ecuador, are well stocked with turtle and codfish. The climate is mild, the sea is calm, and there is abundant salt. There are extensive coal deposits in the province of Azuay and gold and silver in the provinces of Loja, El Oro, and Esmeréldas. Ecuador is a rich country awaiting development, where there are opportunities for the capital and spirit of foreigners.

The Republic has good currency, cheap labor, plenty of water power, abundant raw material of superior quality, many rivers on the coast for transportation, and a railroad into the interior. But the doors of trade cannot be opened unless the merchants and capitalists of this country heed the invitation and enter the markets, in which they are assured a preferred place, and lay the lines of mutual trade relations that will redound to the advantage of the countries concerned.

This initiative must be found here, and it is certain that commercial interests of this country and the American investors will put the sickle into the field sowed by our great Secretary of State, the Hon. Elihu Root, and already ripening.

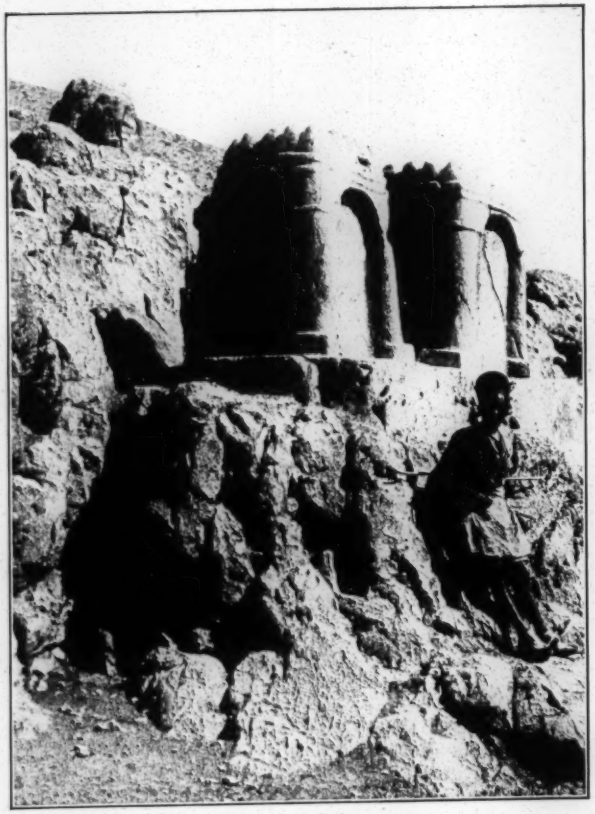
Germany, Great Britain, and France are in the field, Great Britain having a larger trade balance to her credit than this country enjoys. The success of the European trader is due to his closer study of the needs of the people. They have their particular predilections in trade, and these can only be ascertained by a careful study of their lives and wants.

America has the world as her market, but it is in the line of self-interest that she should stimulate, encourage, and develop the South American trade.

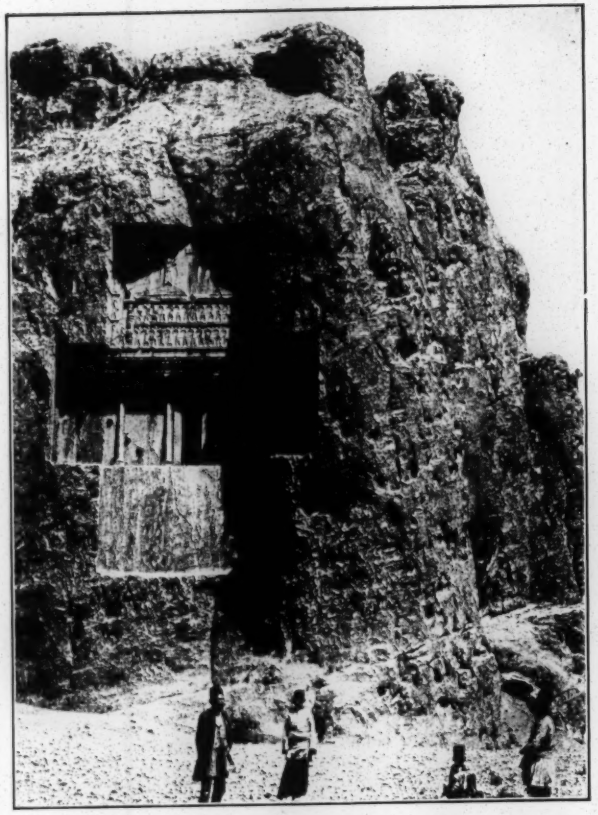
PERSIA—PAST AND PRESENT*

THE recent death of the Shah of Persia and plans in that country for a constitutional assembly lend special interest to this handsome volume. The author, who is professor of Indo-Iranian languages in Columbia University and a well-known writer on the Zoroastrian beliefs, describes some extensive journeys through the ancient kingdom. The chapter on the ruins of Persepolis, which was founded by Darius the Great in 500 B. C., and which flourished for many centuries thereafter, is particularly interesting. Through the courtesy of Messrs Macmillan Co., the publishers, we are enabled to republish

*Persia—Past and Present. A Book of Travel and Research. By A. V. Williams Jackson. With more than 200 illustrations and one map. Pp. 490. 6½ by 9 inches. New York: The Macmillan Co. 1906. $4.00 *net*.



Rock Hewn Fire Altar, Persepolis



The Tomb of Xerxes, Carved in a Rock Cliff

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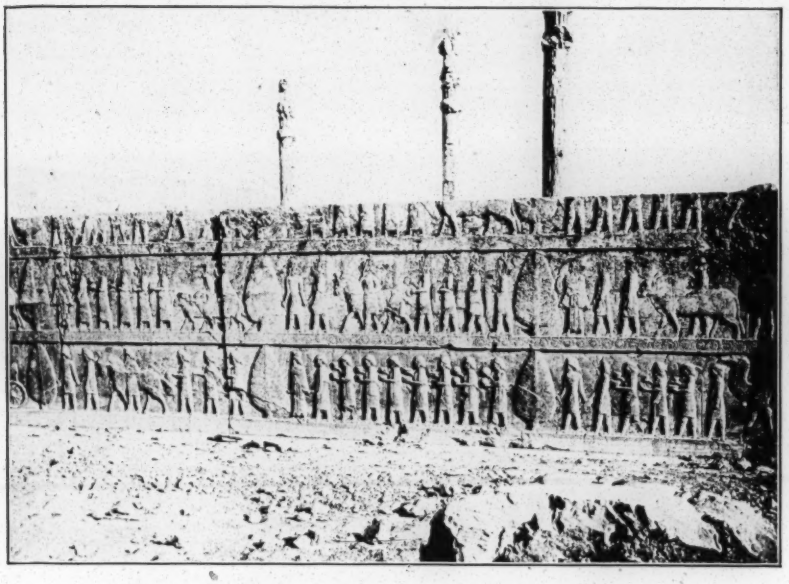
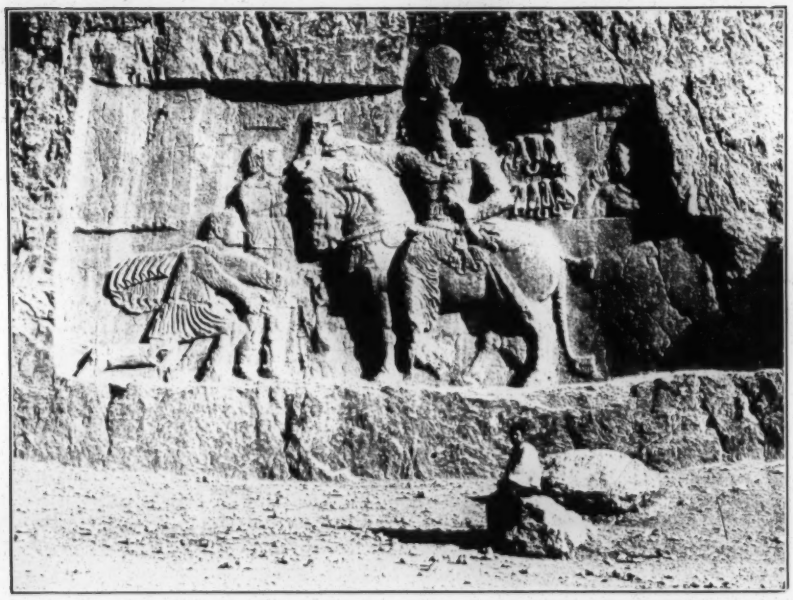


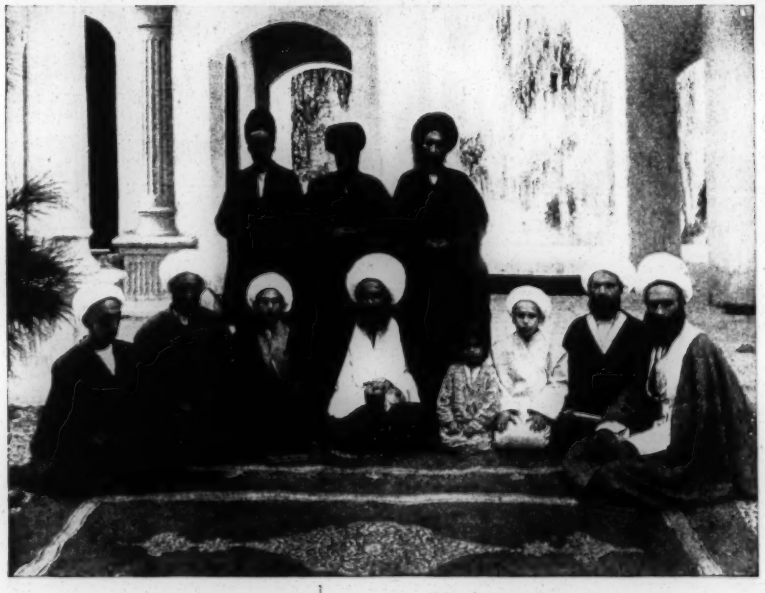
Subject Nations Bringing Tribute to Xerxes



A Rock Panel Below the Tombs of Darius and Xerxes

Carved at least 700 years later. It represents the surrender of the Roman Emperor Valerian (260 A. D.) to the Persian King

The Domed Roofs of Kashan



A Typical Group of Mullahs and Seids

several views of this remarkable city. On page 92 is given an illustration of the portal to what is probably the tomb of Xerxes. There are four such tombs in a row carved out of a solid rock cliff. One has been identified as the tomb of Darius, and the others are probably those of Xerxes, Artaxerxes, and Darius II. The entrance to each is so high that from the ground ropes and ladders must be employed to reach it. Each tomb is a lofty chamber entirely carved out of rock, now empty except for numerous bats and birds. But even more wonderful are the vast masonry terrace on which were built the palaces of the kings and the triple wall surrounding it. Here Alexander the Great, according to tradition, held a great orgy, and then burned the palaces and the royal library, with all its manuscripts, in order that posterity might know nothing of its former grandeur. The Mohammedans, who came later, scoured the country for manuscripts. One governor issued an edict that every Zoroastrian should bring him about 14 pounds of Zoroastrian and Parsee books, in order that all these books might be burned, and he concluded his mandate with the order that any one who disobeyed should be put to death. No wonder the history of these people is shrouded in mystery.

The publishers are to be commended for the excellent map, an expense which few publishers are willing to incur. A valuable bibliography and index are also given.

AN ICE WRAPPED CONTINENT*

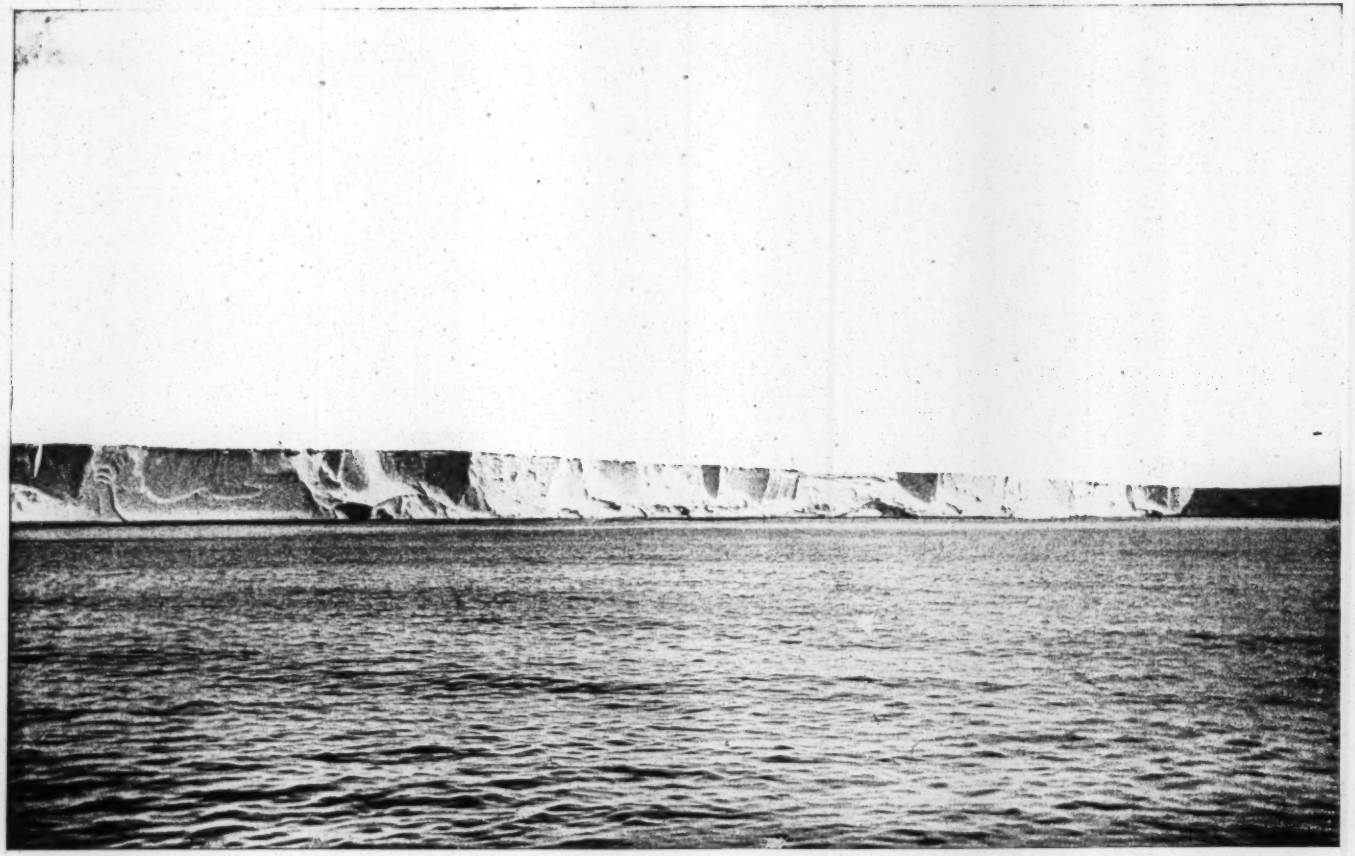
TO the south of Magellan Strait there is a supposed continent, twice the size of the United States, which is justly called the most mysterious land in the world. During the last few years five expeditions from as many nationalities have sought to unravel the wonders of this vast region, but only one expedition, the British South Polar expedition under command of Captain Robert F. Scott, R. N., has succeeded in getting near enough to do exploring work. This expedition was planned by the Royal Geographical Society of London and assisted financially by the Royal Society and by the British government. It sailed from London July 31, 1901, on *The Discovery*, which had been especially built for the work, and returned to England September 10, 1904. An unfortunate attack of scurvy during the first year, caused by tinned meats, and the fact that three relief ships were sent after it, unnecessarily it developed afterward, at first somewhat dampened the enthusiasm with which the discoveries of the expedition were received, but the scientific reports now appearing show that immense additions have been made to our knowledge of the "bottom of the globe."

Captain Scott was very wise as well as fortunate in his choice of base, which he established at the western end of the great ice barrier, under the shadow of two lofty snow-clad volcanoes, Mounts Terror and Erebus, which Ross had seen in state of violent eruption 60 years before. To the east stretched the unending plain of the ice barrier, while to the west towered a great range of mountains, with peaks 9,000 feet in height. The first year efforts were concentrated in exploring the ice barrier, and the second to discovering what lay behind the chain of mountains.

THE GREAT ICE BARRIER

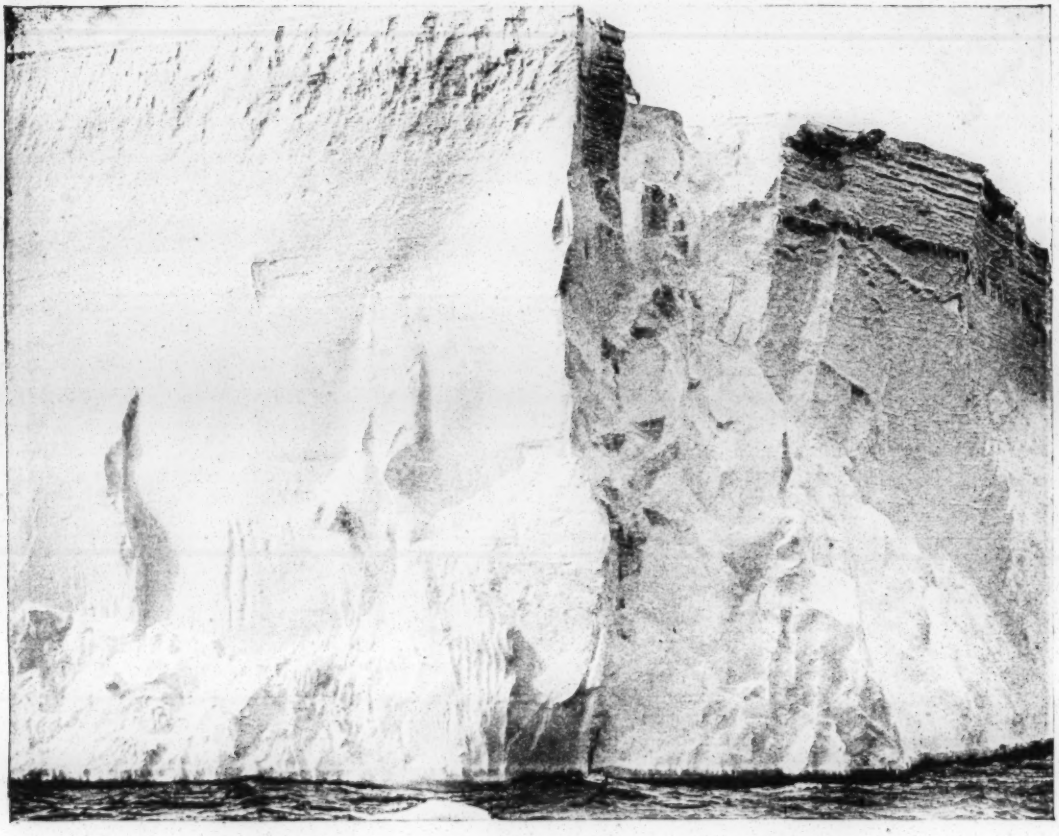
"Perhaps of all the problems which lay before us in the south, we were most

*A review of "The Voyage of *The Discovery*," by Captain Robert F. Scott, with 260 full-page and smaller illustrations, by Dr. E. A. Wilson and others, 14 colored plates, and 2 maps. 2 vols., 556 and 508 pages. New York: Imported by Charles Scribner's Sons. $10.00 *net*.



The Great Ice Barrier

Captain Scott sailed for 500 miles along this continuous cliff of ice, which rises from 10 to 280 feet above the sea. He also traveled 400 miles over it straight into the interior—from 78° to 82° 17′ south latitude—but even then did not reach or see its end. The barrier is afloat, but is apparently wearing away at the rate of about one-half mile a year. Captain Scott reports that it has receded 30 miles since Sir James Ross examined its front. This and succeeding illustrations are from "The Voyage of *The Discovery*," by Captain Robert F. Scott



The Highest Ice Wall Seen (about 280 feet in height)

keenly interested in solving the mysteries of this great ice-mass. Sixty years before, Ross's triumphant voyage to the south had been abruptly terminated by a frowning cliff of ice, which he traced nearly 400 miles to the east; such a phenomenon was unique, and for sixty years it had been discussed and rediscussed, and many a theory had been built on the slender foundation of fact which alone the meager information concerning it could afford."

Before taking *The Discovery* to her permanent quarters, Captain Scott coasted along the entire front of this barrier, and determined that it extended from the volcanoes Erebus and Terror for nearly 500 miles to an ice-clad land on the west, which he discovered and named King Edward VII Land. When he afterward charted the track of the ship he found he had sailed from 20 to 30 miles farther south than Ross had done; in other words, that 20 to 30 miles of ice barrier had worn off since Ross had seen it.

At one point he halted the ship and moored her to the barrier for a day, while different members of the staff ascended in a captive balloon to 800 feet elevation. While lying alongside the ice wharf for 24 hours, the ship and wharf rose and fell together. The depth of water here was 315 fathoms.

Captain Scott makes the important observation that the surface current set into

Another Portion of the Ice Barrier, Showing How It Wastes Away

the barrier and under the ice for a certain time, then turned and set out again to sea. It would be very interesting to know how far "inland" this flux and reflux penetrates.

During the first spring and summer Captain Scott, Lieutenant Schackleton, and Dr Wilson advanced 400 miles due south across the barrier to 82° 17′ south latitude. When they halted they could see to at least 84°, but the barrier still stretched ahead, apparently unending. If the dogs had not failed the party, they would probably have succeeded in getting farther, but, as it is, they beat the record for the "Fartnest South" by several degrees.

This ice barrier is probably thrust off of some great body of land enveloping the South Pole. While the barrier is wearing away in front, as proven by the fact of its retreat of 30 miles in 60 years, it is being constantly fed in the rear; in fact, its recession in front would be considerably more rapid if the loss was not balanced by additions in the rear.* How far off the source is, is a mystery; and when we bear in mind the scarcity of precipitation in such southern latitudes, it is almost impossible to imagine where the supply is to be found.

Examining the Ice Barrier from a Balloon

The following year Lieutenant Royds led a party about 100 miles across the barrier to the east. Like Scott, he found it level everywhere.

It was on this journey also that a most interesting series of magnetic observations were taken by Bernacchi, who carried with him the Barrow dip circle, an especially delicate instrument. The great value of these observations lies in the fact that they were taken in positions which were free from all possible disturbances, either from casual iron or from land masses; the positions also run in a line which is almost directly away from the Magnetic Pole, and consequently the series is an invaluable aid to mapping out the magnetic conditions of the whole of this region.

*Voyage of *The Discovery*, vol. 2, p. 421.

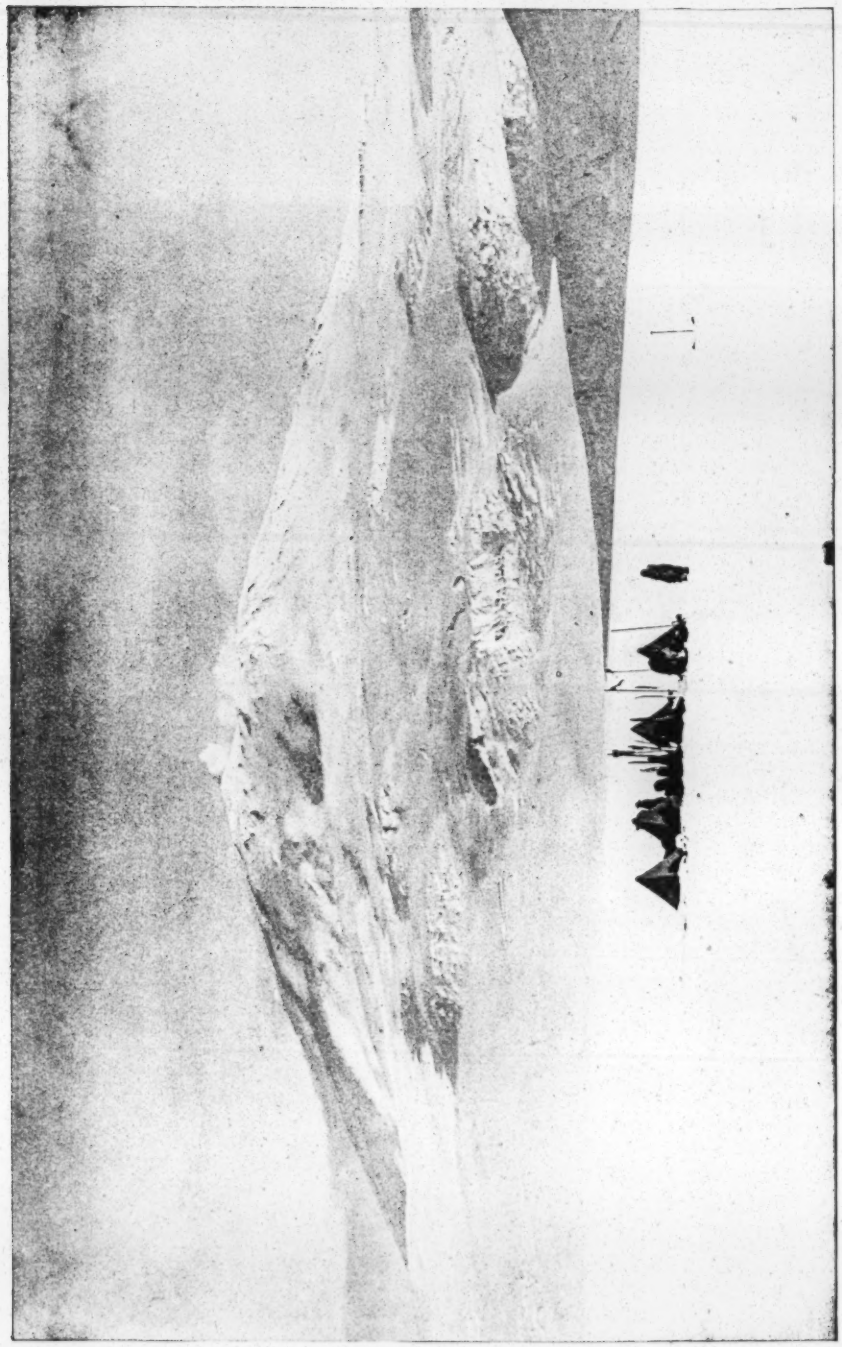
THE MOST DESOLATE LAND IN THE WORLD

During the entire march of 400 miles southward over the ice barrier, Captain Scott had been flanked by a lofty mountain chain on the right at a distance of about 50 to 30 miles. The peaks he named after prominent Englishmen and supporters of the expedition, Mount Markham (15,000), Mount Longstaff (10,350), etc. At the end of the march he had tried to reach this land, but an immense chasm (page 102) barred his way. On his return to the ship, after an absence of 93 days, he found that Lieutenant Armitage had discovered a route across this chain of mountains, beyond which he reported a limitless ice-covered plateau at an elevation of 8,900 feet and flat as a table. Armitage, however, did

A View of the Ice Barrier, Looking Down from a Balloon

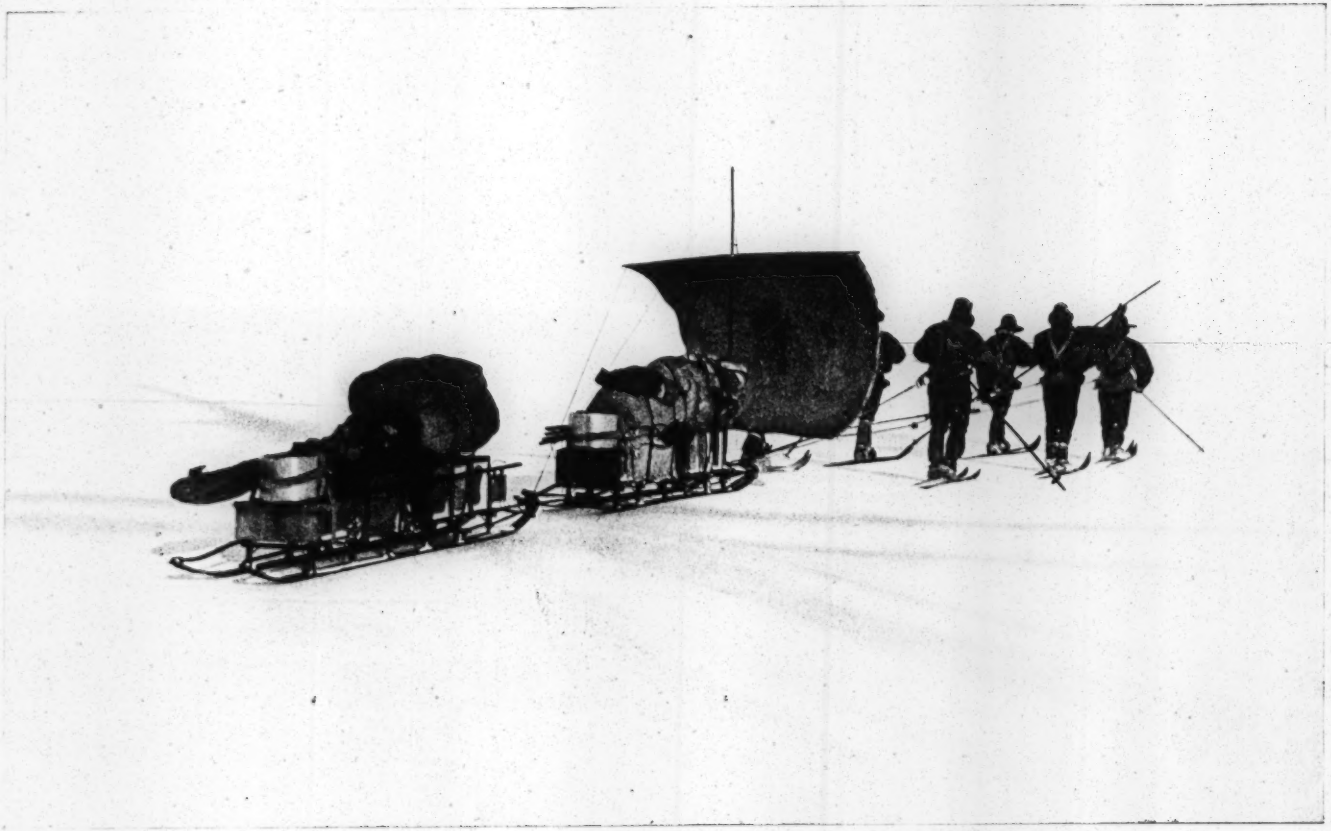
Dog Team on the March

The Chasm which Prevented Captain Scott from Reaching Land at the End of His 400-Mile March up the Ice Barrier



A View of Erebus from the South

The volcano is 13,120 feet high. It was constantly emitting smoke and glowed red at night, but no violent eruption occurred during the two years the expedition was in its neighborhood



Advancing Over the Great Inland Plateau

Nine thousand feet above the sea, discovered by Scott and Armitage. The most desolate land in the world, where the temperature in midsummer often falls to 40 degrees below zero

not attempt to advance across the plain. The following year Captain Scott and several companions ascended to this plateau by Armitage's route. Their dogs had all failed and the men were obliged to drag the heavy sledges. It was a heavy pull, as they had to climb 9,000 feet in 70 miles, up a rough glacier.

Captain Scott traveled to the westward about 200 miles across this plateau, which did not vary in altitude more than 60 or 70 feet. At one point he passed directly south of the Magnetic Pole.

"The error of our compass had passed from east to west and was nearly at its maximum of 180°; although I could not calculate it accurately at the time, I could get a good idea of its amount by observing the direction in which the sun reached its greatest altitude. The reader will see that from a magnetic point of view this was a very interesting region. We were directly south of the South Magnetic Pole and the north end of our compass needle was pointing toward the South (geographical) Pole.

"To show what a practical bearing this reversal of the compass had, I may remark that in directing Skelton on his homeward track to the eastward, I told him to steer due west by the compass card. It is only on this line or the similar one which joins the northern poles that such an order could be given, and we were not a little proud of being the first to experience this distinctly interesting physical condition in the Southern Hemisphere.

"There can be little doubt, I think, that the wind blows from the west to the east across this plateau throughout the winter, and often with great violence, as the high snow-waves show. What the temperature can be at that season is beyond guessing; but if the thermometer can fall to −40° in the height of the summer, one can imagine that the darker months produce a terrible extremity of cold.

"The interior of Victoria Land must be considered the most desolate region in the world. There is none other that is at once so barren, so deserted, so piercingly cold, so wind-swept, or so fearsomely monotonous.

"When the reader considers its geographical situation, its great elevation, and the conditions to which we were subjected while traveling across it, he will, I think, agree that there can be no place on earth that is less attractive.

"This great ice-sheet is unique; it has no parallel in the world, and its discovery must be looked upon as a notable geographic fact."

ICE-FLOWERS

In his diary, Captain Scott gives the following description of the only flowers they saw:

"*March 30 (Easter Sunday)*.—Like yesterday, a fine day, with a light northerly breeze. This is a season of flowers, and behold! they have sprung up about us as by magic—very beautiful ice-flowers, waxen white in the shadow, but radiant with prismatic colors, where the sun rays light on their delicate petals. It was a phenomenon to be expected in the newly frozen sea, but it is curious that they should come to their greatest perfection on this particular day. The ice is about five inches thick and free from snow; consequently the ice-flowers stand up clear-cut and perfect in form. In some places they occur thickly, with broad, delicate, feathery leaves; in others the dark, clear ice surface is visible, with only an occasional plant on it; in others, again, the plants assume a spiky appearance, being formed of innumerable small spicules.

"The more nearly one examines these beautiful formations, the more wonderful they appear, as it is only by close inspection that the mathematical precision of the delicate tracery can be observed. It is now established that on the freezing of salt water much of the brine is mechanically excluded. Sea-ice is much less salt than the sea itself, and what salt remains is supposed only to be entangled in the frozen water. The amount of salt excluded seems to depend on the rate at which the ice is formed, and while some is

excluded below the ice-surface, some is also pushed out above, and it is this that forms the ice-flowers. The subject is very fascinating, and we have already started to measure the salinity of ice taken from different depths and formed under various conditions; the ice-flowers themselves do not seem to constitute a saturated solution of brine, and why they should differ in form in various places seems beyond explanation."

THE EMPEROR PENGUIN

"We had felt that this penguin was the truest type of our region. All other birds fled north when the severity of winter descended upon us; the Emperor was alone prepared to face the extremest rigors of our climate; and we gathered no small satisfaction from being the first to throw light on the habits of a creature that so far surpasses in hardiness all others of the feathered tribe.*

"Not many birds undertake to lay their eggs in the darkness of a polar winter, nor do many birds appear to think that sea-ice is the most attractive ground to 'sit' on. And when, in addition to this, we find the Emperor penguin hatching out its chicks in the coldest month of the whole Antarctic year, when the mean temperature for the month is 18° below zero, Fahrenheit, and the minimum may fall to –68°, I think we may rightly consider the bird to be eccentric.

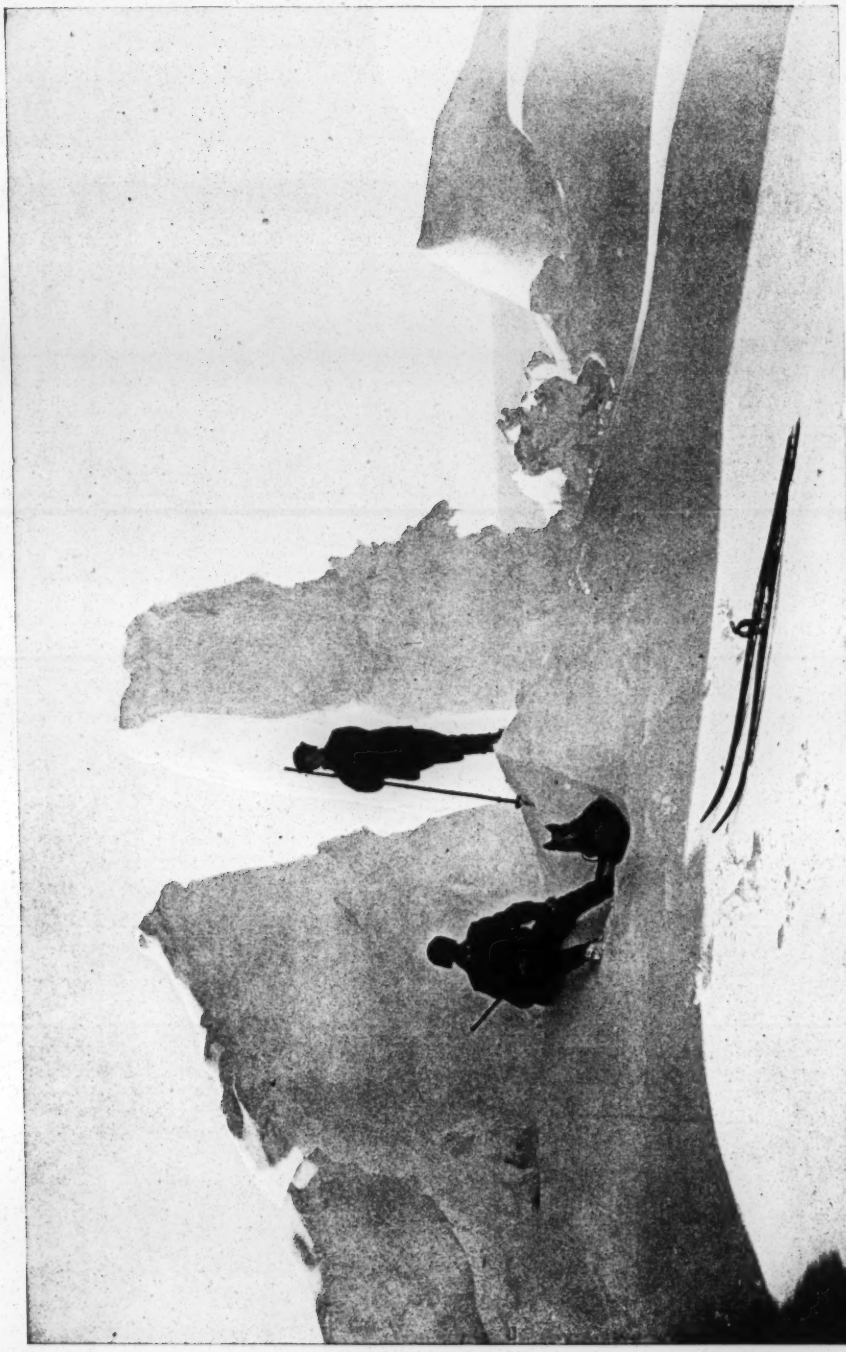
"The Emperor penguin stands nearly four feet high, and weighs upward of 80 to 90 pounds. He is an exceedingly handsome bird, with a rich black head, a bluish-gray back and wings, a lemon-yellow breast, with a satin-like gloss on the feathers, and a brilliant patch of orange on the neck and lower bill. His movements are slow and stately, and the dignity of his appearance is much increased by the upright carriage of his head and bill. When a group of these birds is met with in the middle of the desert ice, where all around is gray and cold and white and silent, the richness of their coloring strikes one very forcibly. Their voice is loud and trumpet-like, and rings out in the pack-ice with a note of defiance that makes one feel that man is the real intruder. They have no fear, but an abundance of inquisitiveness, and a party such as I have mentioned will walk up to one with dignity, and stand in a ring all round, with an occasional remark from one to the other, discussing, no doubt, the nature of this new and upright neighbor.

"The method employed by the Emperor penguin for carrying the egg and chick upon his feet is shared also by the King penguin of the sub-Antarctic area, as we saw in our visit to their rookeries in the Macquarie Islands. The King penguin we saw as he sat in mud and puddles, with his single egg upon his feet, and now we saw the Emperor penguin doing precisely the same thing with his single chicken to keep it off the ice; and we are agreed that the term 'pouch,' which has been used in this connection, is one which not only does not describe the matter, but is anatomically wrong and misleading. The single egg, or the chick, sits resting on the dorsum of the foot, wedged in between the legs and the lower abdomen, and over it falls a fold of heavily feathered skin, which is very loose, and can completely cover up and hide the egg or chick from view. When the chick is hungry or inquisitve, it pokes out from under the maternal (or paternal) lappet a piebald downy head of black and white, emitting its shrill and persistent pipe until the mother (or the father) fills it up.

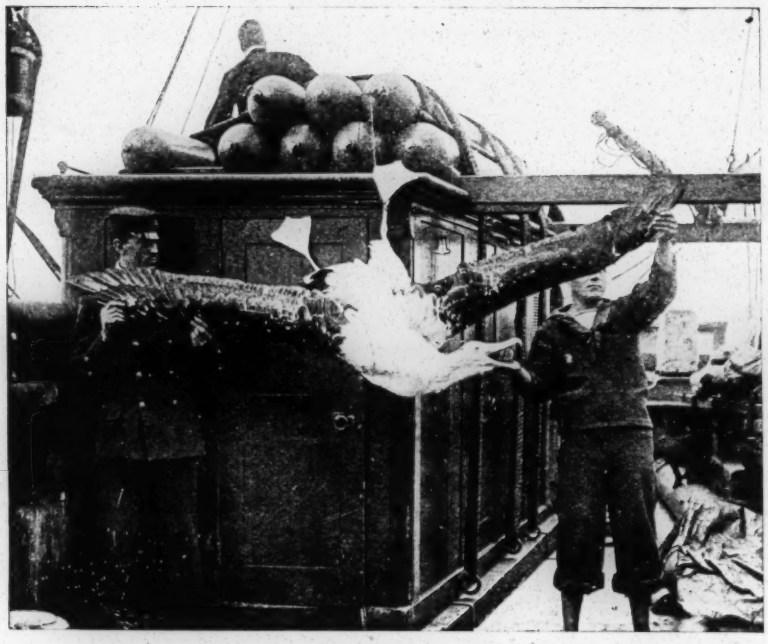
"The feeding is managed as with cormorants and many other birds, the little one finding regurgitated food when it thrusts its head inside the parent's mouth.

"I think the chickens hate their parents, and when one watches the proceedings in a rookery it strikes one as not surprising. In the first place, there is about one chick to ten or twelve adults, and each adult has an overpowering desire to 'sit'

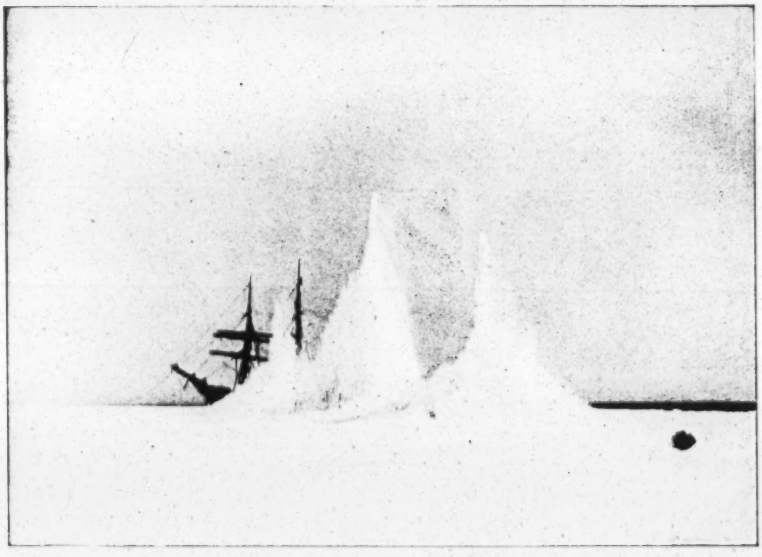
* This description of this remarkable bird is from the chapter on "Antarctic Fauna," by Edmund A. Wilson. Voyage of *The Discovery*, vol. 2, p. 469.



A Pressure Ridge Along the Coast

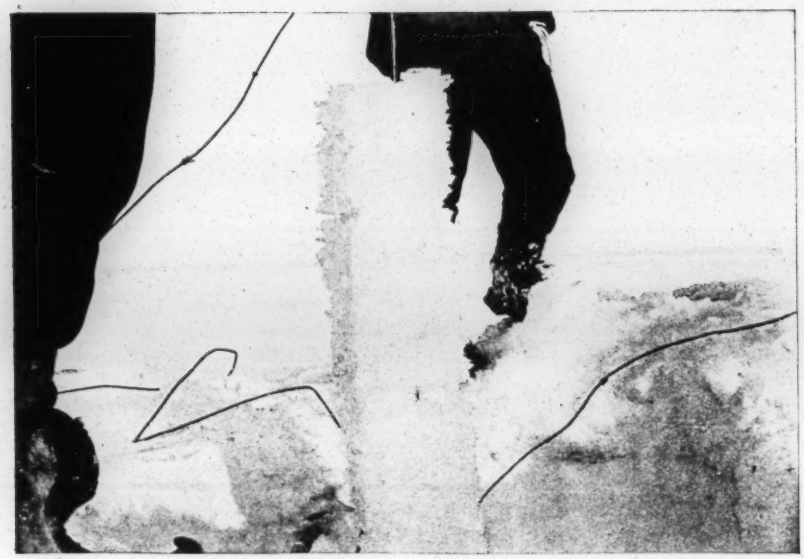


A Wandering Albatross Caught on the Voyage South



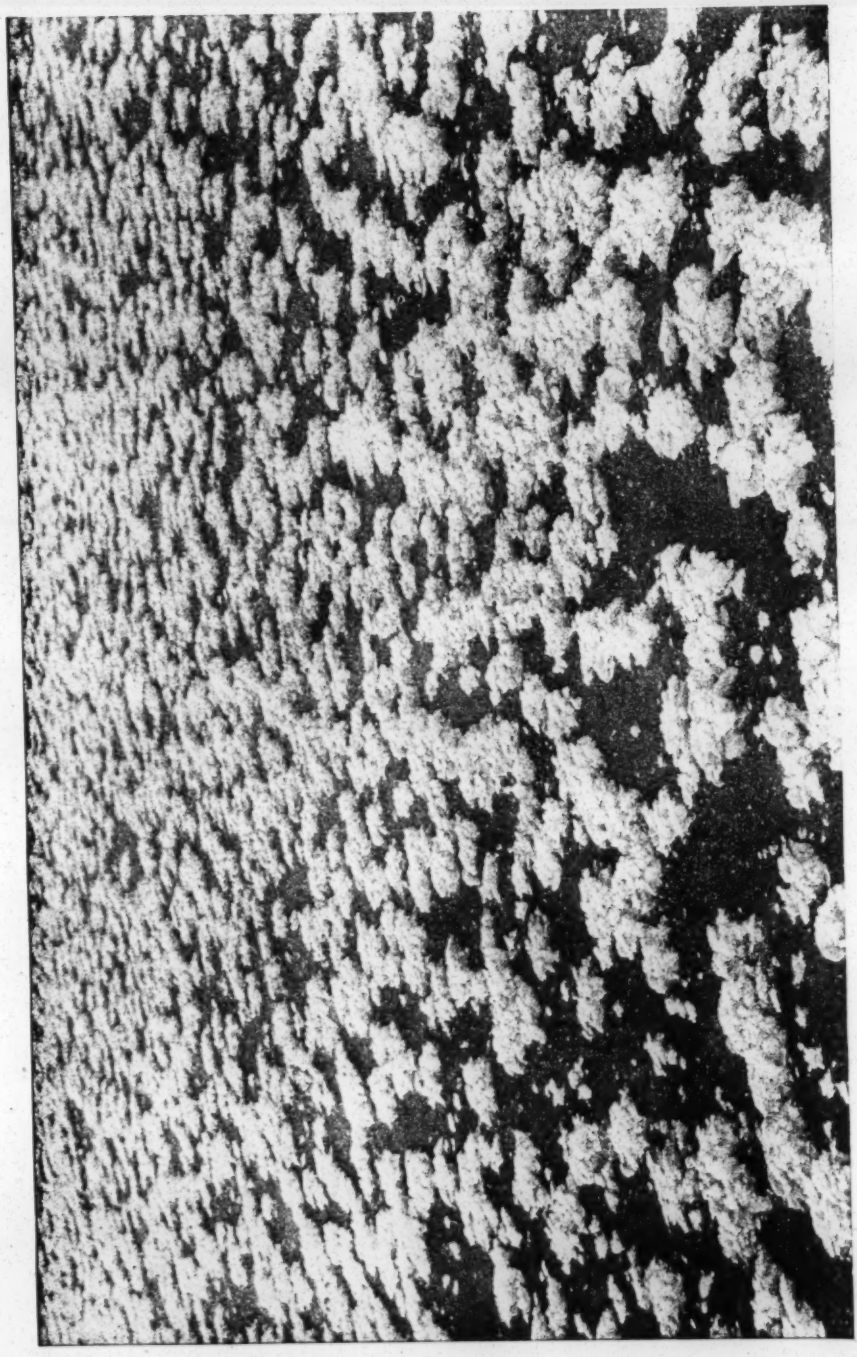
Endeavoring to Free the Ship by Blowing Up the Ice

The attempt was unsuccessful

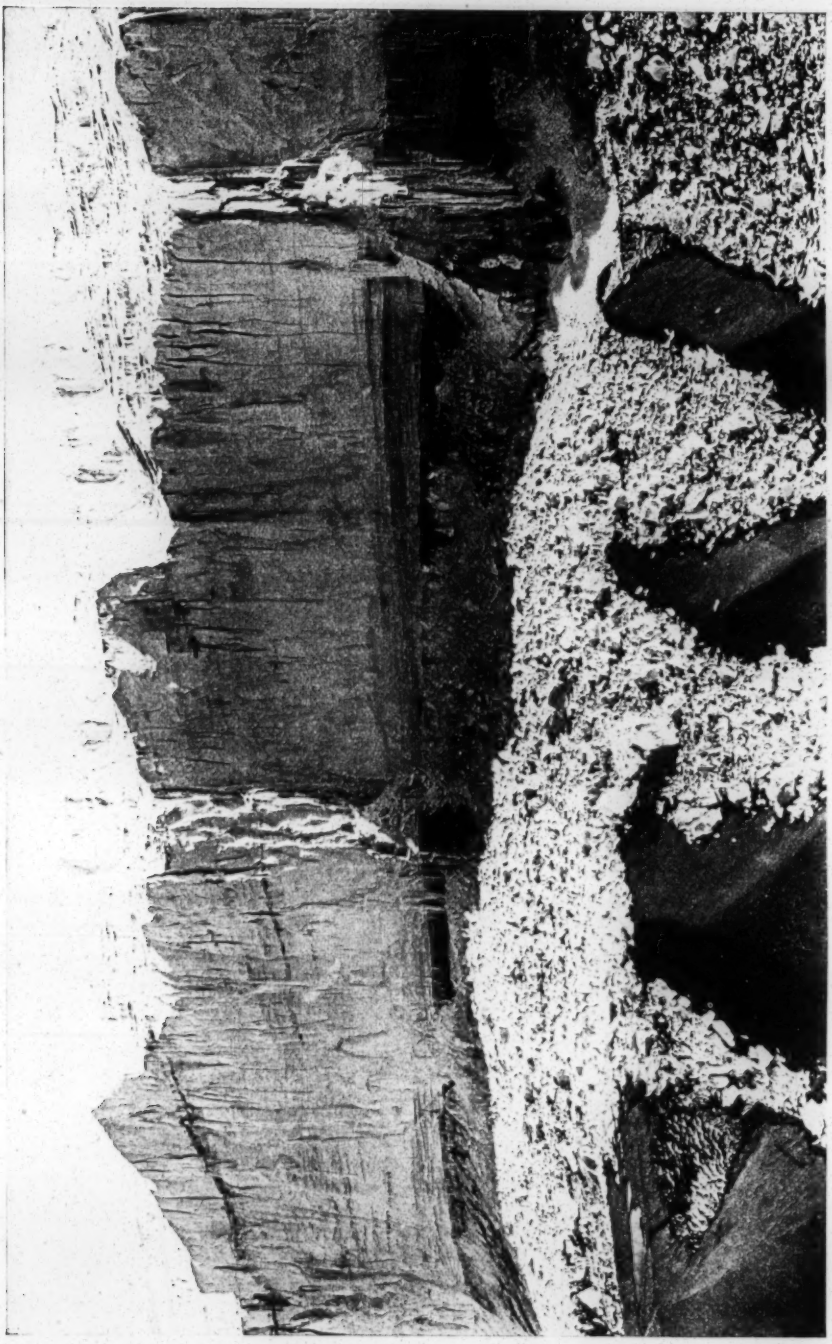


Ice Formed on Submerged Rope

The Hunter Waiting for a Seal to Come Up to Breathe



Ice Flowers. See page 105



The South Side of a Glacier

The Aurora Australis

on something. Both males and females want to nurse, and the result is that when a chicken finds himself alone there is a rush on the part of a dozen unemployed to seize him. Naturally, he runs away, and dodges here and there till a six-stone Emperor falls on him, and then begins a regular football 'scrimmage,' in which each tries to hustle the other off, and the end is too often disastrous to the chick. Sometimes he falls into a crack in the ice, and stays there to be frozen while the parents squabble at the top; sometimes, rather than be nursed, I have seen him crawl in under an ice-ledge and remain there, where the old ones could not reach him. I think it is not an exaggeration to say that of the 77 per cent that die, no less than half are killed by kindness."

SOME INTERESTING OBSERVATIONS

The power of the midnight sun in these latitudes is illustrated by the fact that when several members of a party were caught on a ice-floe for several hours without matches, Dr Wilson was able to produce a light for their pipes from a small pocket magnifying glass. During the summer the biologist of the staff succeeded in growing a crop of mustard and cress. He raised some on flannel and with chemicals, but the best result was obtained from Antarctic soil, "which is evidently most productive."

No vegetation of any kind was seen anywhere, but, on the other hand, they found an abundance of animal life, so that no party wintering in the Antarctic regions will have difficulty in providing themselves with fresh food.

On their ascent to the inland plateau they "passed two more carcasses of Weddell seals; the last was at the greatest altitude we have yet found one, nearly 5,000 feet above the sea; it grows more than ever wonderful how these creatures can have got so far from the sea. We never satisfactorily explained this matter. The seal seems to crawl to the shore or the ice to die, possibly from its instinctive dread of its marine enemies; but unless we had actually found these remains, it would have been past believing that a dying seal could have transported itself over fifty miles of rough steep glacier surface."

The dogs which had been brought from Siberia had the unpleasant experience of molting in winter, which was the Arctic summer, but their fur soon came out again.

The members of the party kept up their good spirits by outdoor games. One of the most spirited contests was a game of hockey April 7 by "The Married and Engaged *vs.* The Single," the match being played in a temperature of –40°.

AMERICAN EXPLORERS OVERLOOKED

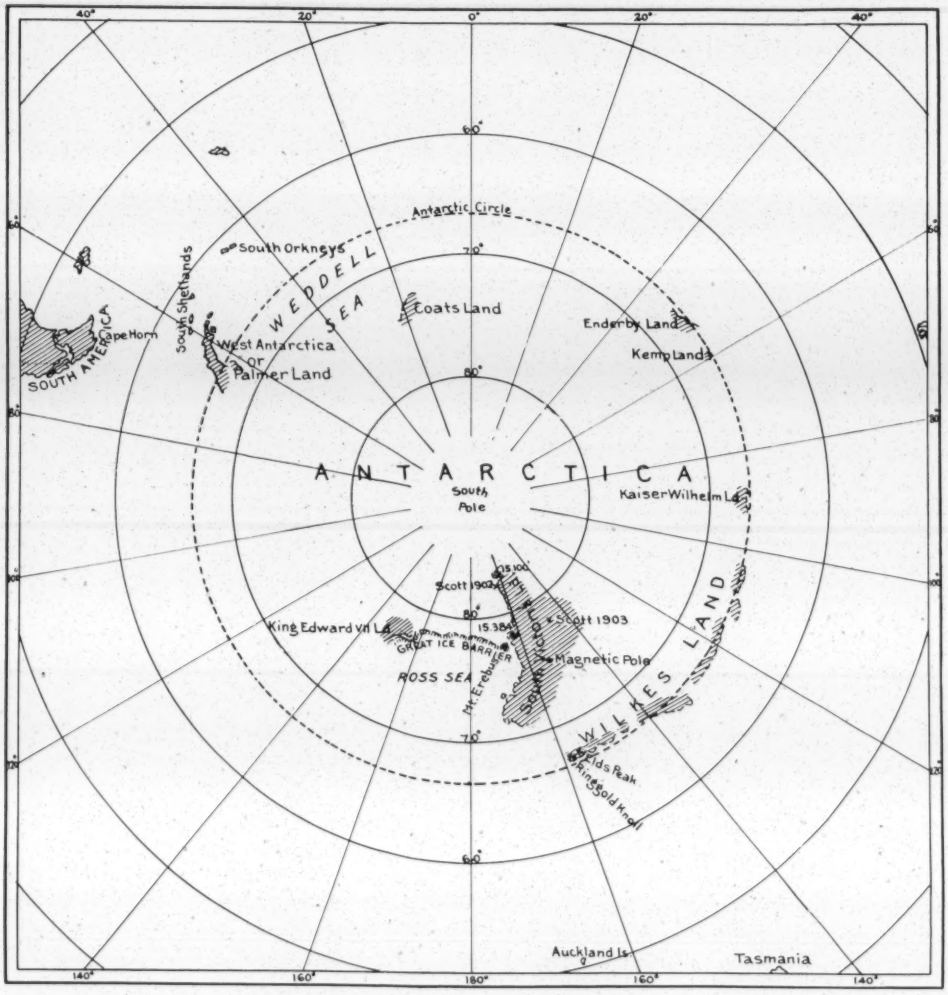
Every one who reads Captain Scott's narrative as given in "The Voyage of *The Discovery*" must admire the strong and hearty personality of the leader. He is full of energy, and not only did the hardest work himself, but was able to get others to follow him willingly and cheerfully. His lieutenants and men likewise command our respect for their courage, fidelity, and faithful work.

It is unfortunate, however, that in his résumé of what has been done in the far south by previous explorers he completely overlooks the two Americans who discovered the Antarctic Continent—Palmer, who first saw the western half of the continent, now called West Antarctica, and Admiral Charles Wilkes, who first sighted and defined the eastern half of the continent, known as Wilkes' Land.

To quote Major General A. W. Greely, U. S. Army:

"Captain Scott is happier as an explorer than as an historian. From his narrative and charts is absent the name of the American who discovered the Antarctic Continent, Captain N. B. Palmer. Further, not only does Scott omit mention of Palmer and erase his name from the Antarctic map, but he gives the credit for the first discovery of land in the Antarctic regions to the distinguished Russian navigator, Bellinghausen.

"The discovery in the summer of 1820-1821 of Palmer Land, from the summit of



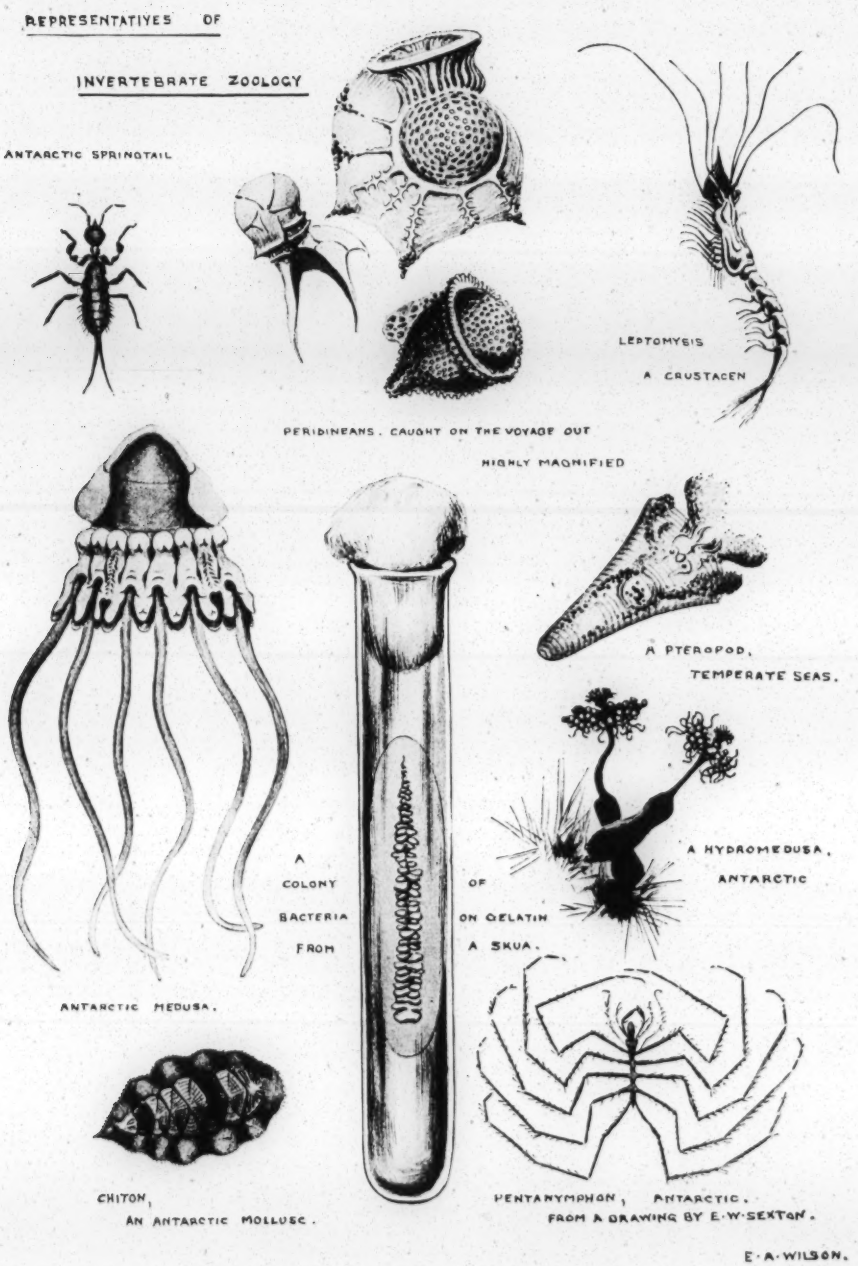
Outline Map of South Polar Regions

Deception Island, South Shetlands, is described in Fanning's Voyages, p. 435. Captain N. B. Palmer, in the sloop *Hero*, visited this land, and on his return passage fell in with Bellinghausen, whom Palmer informed of the mountainous land to the south."

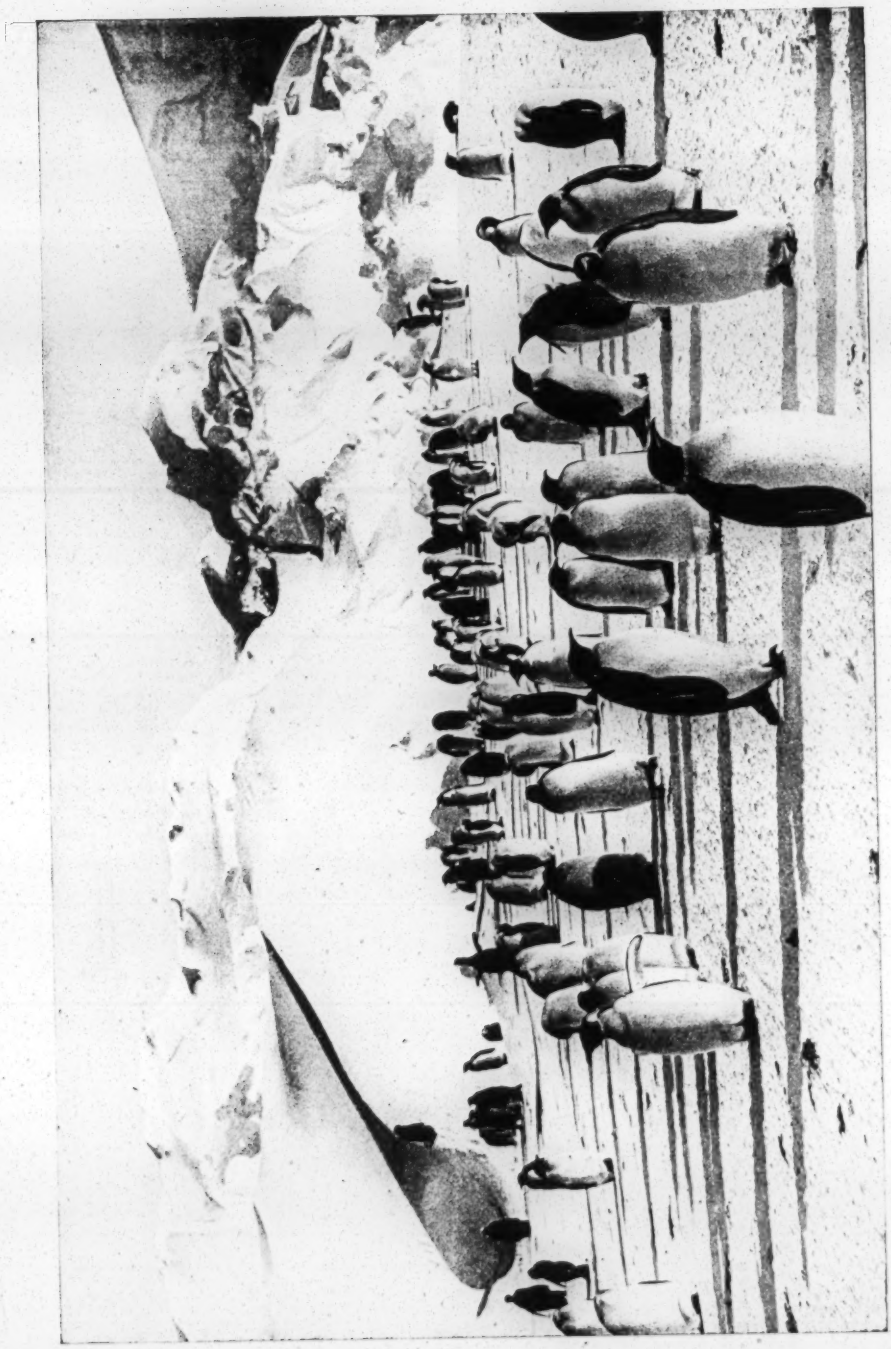
But more remarkable was the voyage of Admiral Charles Wilkes, in 1840. To quote Edwin S. Balch, author of "Antarctica:"*

"With unsuitable, improperly equipped ships, amid icebergs, gales, snowstorms, and fogs, Wilkes followed an unknown coast line for over 1,500 miles, a distance exceeding in length the Ural Mountains. It is the long distance which Wilkes traversed which makes the results of his cruise so important, for he did not merely sight the coast in one or two places, but he hugged it for such a distance as to make sure that the land was continental in dimensions. The expedition noticed appearances of land on January 13; it

*NATIONAL GEOGRAPHIC MAGAZINE, 1903, p. 218.



Representatives of Invertebrate Zoölogy



A Rookery of Emperor Penguins

For the remarkable breeding habits of this eccentric bird see page 106

Emperor Penguin and Chick

sighted land almost surely on January 16, from 157° 46′ east longitude, and again more positively on January 19, from 154° 30′ east longitude, 66° 20′ south latitude. On January 30 the size of the land was sufficiently ascertained to receive the name 'Antarctic Continent,' and this discovery of Wilkes is the most important discovery yet made in the Antarctic."

Impartial geographers in due time recognized the importance of Wilkes' discovery, and in recognition of his work affixed the name Wilkes Land to the portion of the Antarctic Continent along which he coasted.

The homeward track of *The Discovery* disproved the existence of merely a small part of Wilkes Land, namely, Eld Peak and Ringold's Knoll, to the east of Adelie, but Captain Scott adds that "whilst it is certain that we must reject Wilkes Land to the eastward of Adelie Land, Wilkes' soundings still remain as a guide to the limit of the continental plateau in this region. Our own uniform soundings of 250 fathoms, together with his, show that there is considerable extent of shallow sea, limited more or less by the track of the Wilkes' ships, approximately along the Antarctic Circle."

The German South Polar expedition confirmed the opposite end of Wilkes Land in 1902.

G. H. G.

THE BATHING AND BURNING GHATS AT BENARES

By Eliza R. Scidmore

Foreign Secretary of the National Geographic Society

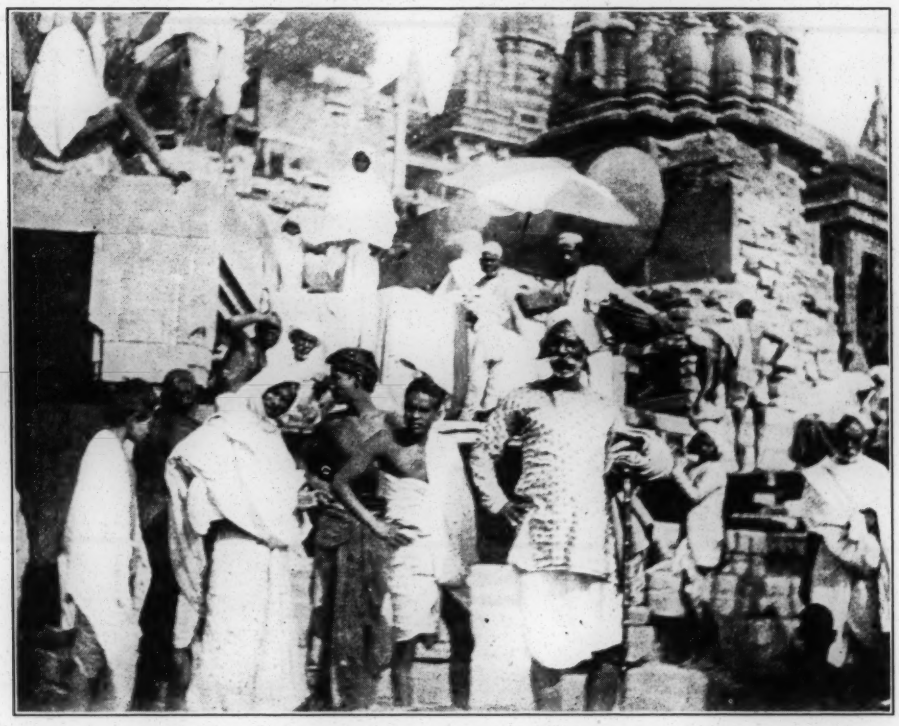
Copyright by the National Geographic Society, 1907

THE greatest human spectacle in India, the most amazing and complete exhibition of blind religious zeal and superstition in all heathendom, is the sunrise gathering of Ganges worshipers along the river bank at Benares. It is such an incredible thing that the winter tourist cannot realize that he sees the spectacle when the fewest Hindus are taking part; and it is impossible to conceive how the thirty and fifty thousand bathers of a winter's morning, are doubled and trebled on the occasions of the great summer festivals, and the imposing river front of the sacred city is one solid mass-meeting three miles long. The half cannot be told one, and roaming up and down the river front two and three mornings in succession leaves one as much amazed and impressed as on a first morning. One has heart-sinking doubts of the Christian missionaries ever being able to make headway with such a people, against such bigoted zealots. But, as Gautama Buddha once won them from Hinduism at this very place and held them to his purer faith for generations, they can be converted again.

THE SACRED CITY

Benares, as a sacred city resting on Shiva's trident spear, has been the goal of Hindus for all of thirty centuries. The pious one seeks Benares in sickness and in health, in prosperity and in adversity, to beseech the gods, to implore their aid, to vow rewards to them and to fulfill those vows. The dream of his life is to retire to Benares in his old age, to die in sacred Kasi, to have his body cremated at the edge of "Mother Ganges" and the ashes committed to her flood. Every Hindu prince and noble and rich man has a house at Benares, and it is the acknowledged center of learning and culture of the Hindu world. Literature and astronomy have flourished there for ages, and colleges of western learning instruct in the exact sciences and even sanitary science; yet the old observances prevail and the Hindu changes his spots no more than the leopard—for a little matter of memorizing the words of a few dozen English text books. He may lead a life outwardly conforming to European conventions and customs, but, when ailing, he seeks Benares, to be cured by the touch and taste of Ganges water; and dying, he begs to be buried within sight of the spires and shrines that line the ghats.

Benares stretches for three miles along the left, or west, bank of the Ganges, that there turns northward, and all the city's extent is sacred ground. Who dies there on the left bank is sure of exalted estate hereafter; while the right bank is desolate and accursed, and whoever dies on that stretch of Ganges shore becomes a donkey in the next incarnation, without hope forever. One bank of the muddy stream is steep and high, crowded with palaces, temples, and hanging gardens, with the broad, magnificent flights of steps, called ghats, sweeping down between them to the river's edge. The opposite shore is low and sandy—a flat land, useful only for sunrise effects. The Maharajah of Benares has a white marble palace on the right bank, far up stream, its terraces and marble-screened balconies commanding a noble view of the whole stately city front; but the prejudice is not allayed. No one dies in this Ramnagar palace, nor in the village behind it, if mortal effort can prevent. The dying are bundled into boats in



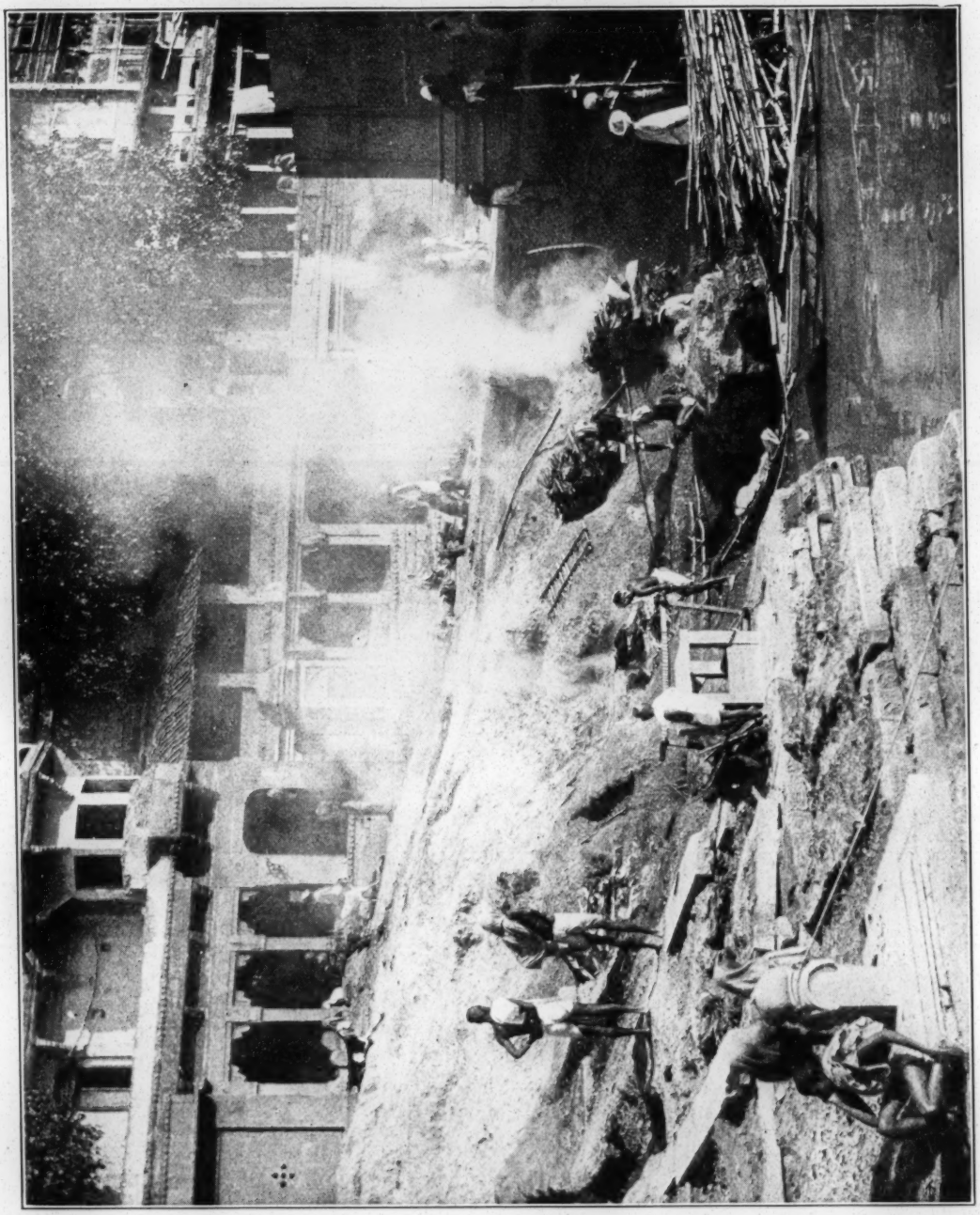
Morning Strollers on the River Bank, Benares

panic haste, for it is as good to give the death rattle on Mother Ganges' breast as on the Benares shore.

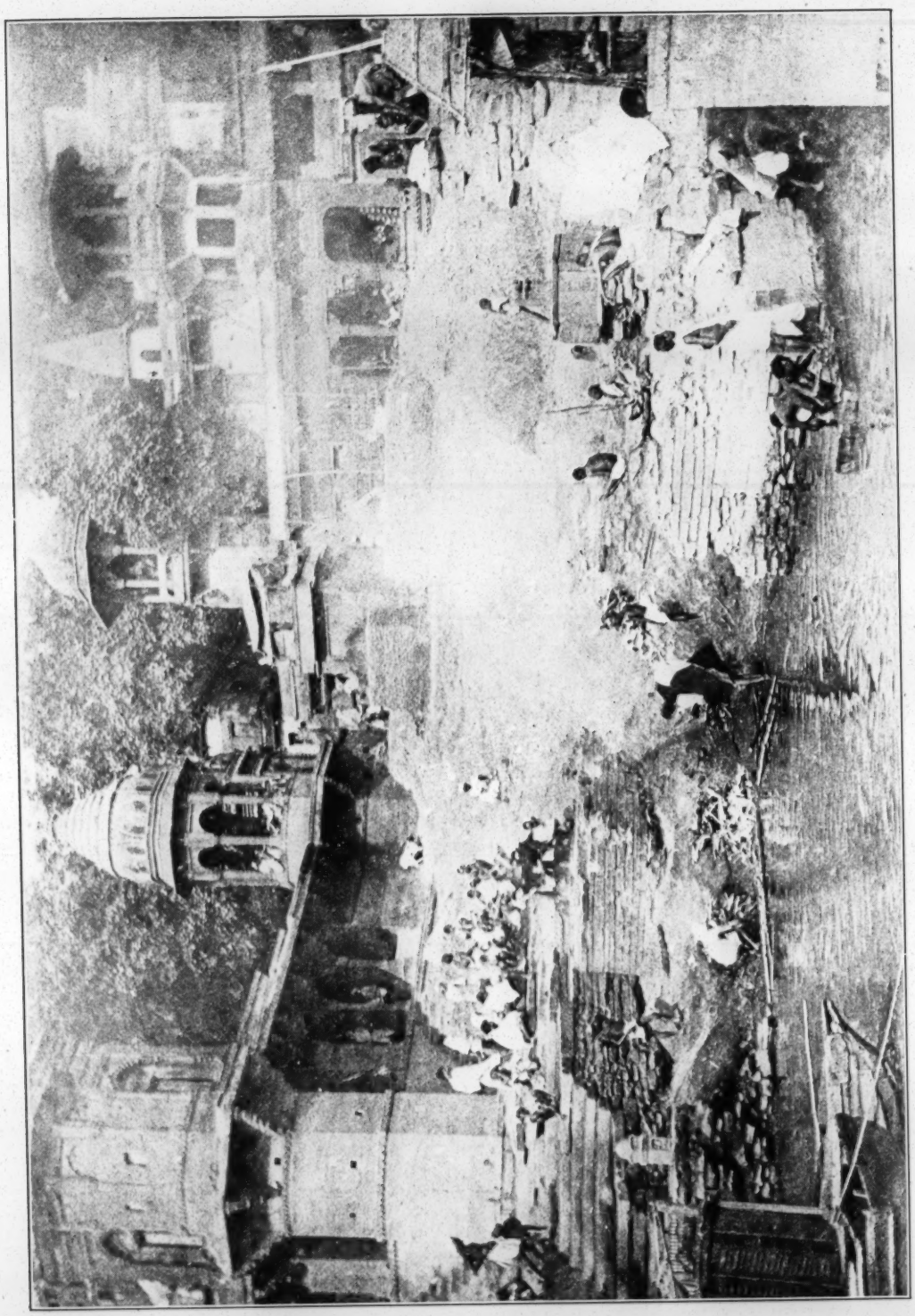
The traveler coming up from Calcutta gets a bewildering and better view of the splendid city front as he crosses the high railway bridge across the Ganges—the fortified iron structure made real to every one in Mrs Flora Annie Steel's "Voices of the Night." Then the long fantastic line of the ghats is succeeded by three miles of suburbs, of dingy plaster and adobe walls and dusty tamarind trees, the commonplace railway station, and the vast spaces of the Cantonment, or European settlement. A British regiment is always quartered beside this hotbed of fanaticism, political conspiracy, and disaffection and all heathenish possibilities. The officers and the many officials of the civil service give Benares a considerable English community, that has its church and club, its tennis courts and polo ground.

Sight-seeing begins at Benares before daybreak, and one drives through the two miles of uninteresting streets in the starlight and gray gloaming, across to the boats at the river bank. In midwinter, the "cold-weather" months of Indian travel, it is bitterly cold at that hour—hoar frost on the ground, blue and lilac frost haze in the air. One needs all the fur wraps and rugs he can get to drive down to the river, yet is glad for the shelter of a sun umbrella before noon.

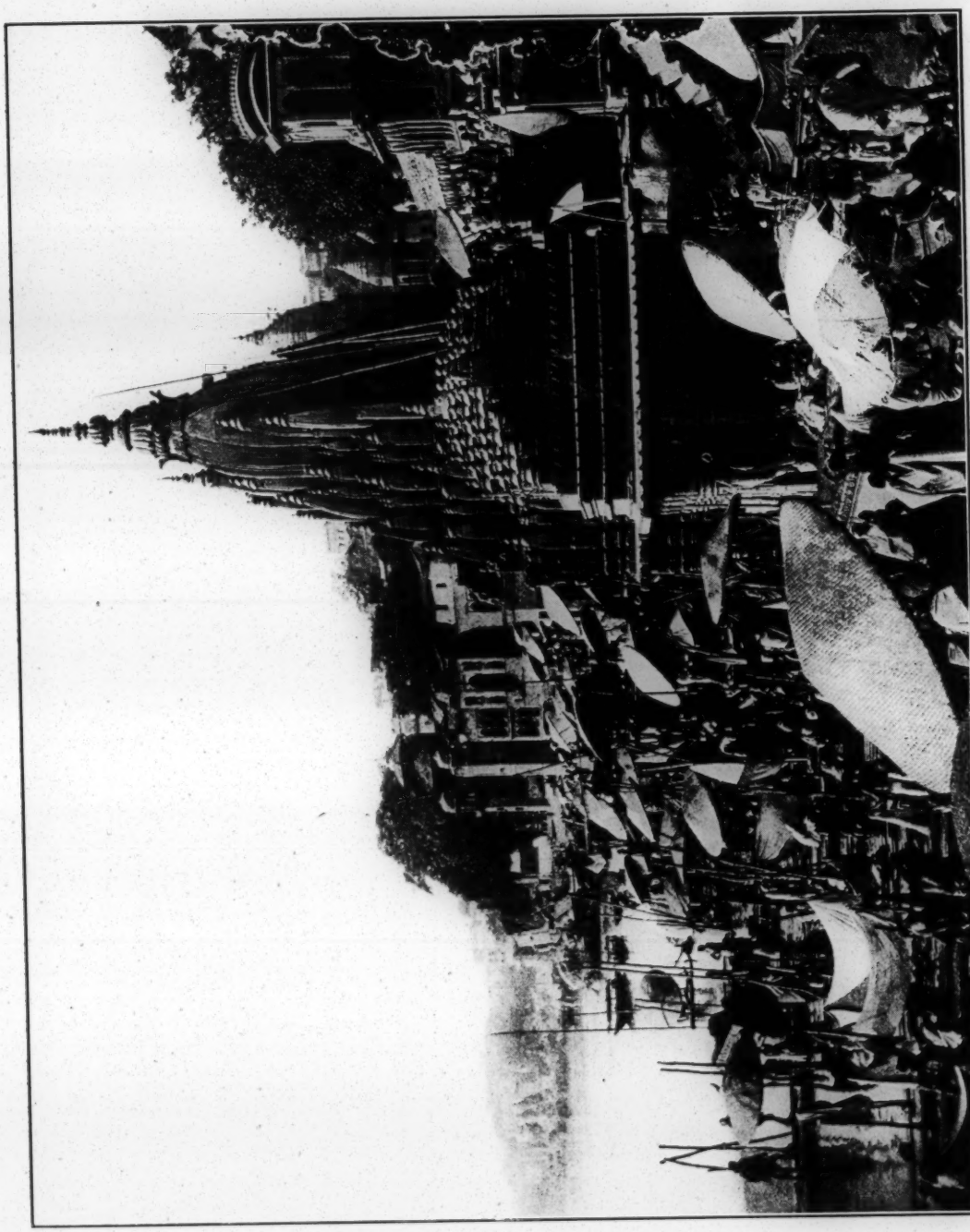
Every one at that hour was hurrying in the one direction, and when we had raced down the great steps and the houseboat was poled off from the bank, all the river front was before us like a theater stage lighted by the rising sun striking full upon it. As the sun shone



The Burning Ghat at Benares



Cremation in Progress, and Domris Washing Human Ashes at Water's Edge



The Bathing Ghats Along the Ganges, Benares

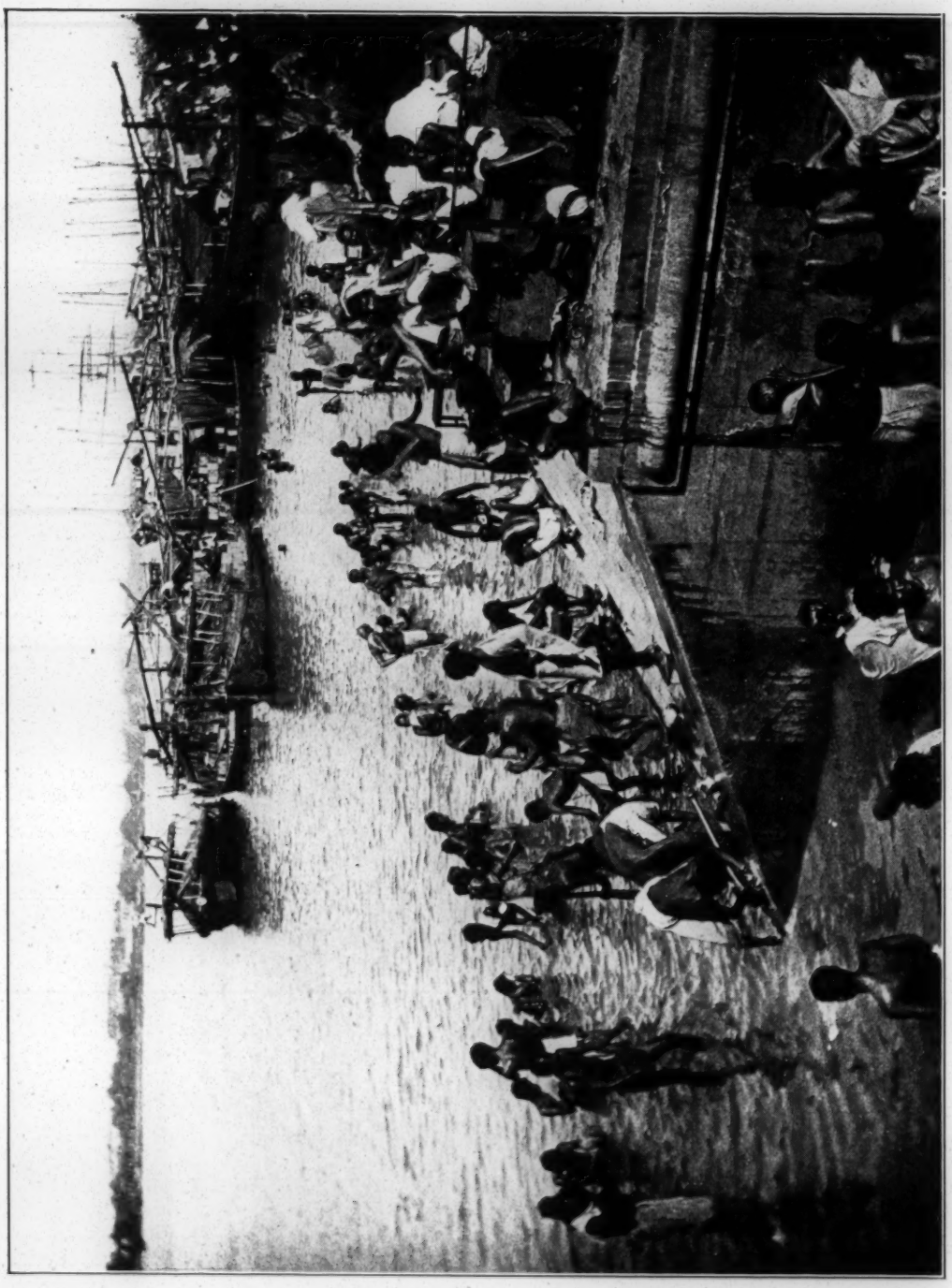
red, orange, and yellow through the thick frost haze, a great murmur of voices rose from the length of the ghats, the tens of thousands of fervent worshipers, standing on platforms built over the water and standing waist deep in the water, repeating in muttered chant the ancient Vedic hymn. They dipped themselves beneath the swirling mud flood; they lifted the water in jars and poured it over their heads; they lifted it in their hands and let it trickle through their fingers or run down their arms, and they dipped tufts of sacred grass in the water and sprinkled themselves; they pressed their nostrils, they twisted their fingers, and did all manner of motions as they chanted and muttered to themselves, each one rapt, intent, absorbed entirely in the long religious recitals. They paid no heed to us, nor to any happenings, for the Hindu ritual is so elaborate and exacting that if they should make a slip or omission, they would have to begin the long ritual all over again. For the priests and high-caste Brahmans, the daily prayers are of two hours' duration by the water side, and continue all day; but the ordinary man of Benares' bazars gets his morning ceremony done in far less time, wades back to shore and dry garments, spots and stripes himself with fresh caste marks for the day. He fills a brass jar with water and strolls along the ghats with the crowd, stops for a prayer or two, salaams to a cow or two, pours his water offering over some greasy black image, and his religious work is done.

There is no evidence at the ghats that Hinduism is dying out, but the census tables give one gratifying data. Not every believer goes to the Ganges each morning, by any means. Tens and tens of thousands must shirk their religious duties entirely; for, as the city has a fixed population of 222,400 and a floating population of ten to thirty thousand, it is only an eighth or tenth of them all that hail the sun across Mother Ganges. There are eighty thousand priests fattening in Benares temples, yet they are not all there at the river's brink either. All who go are in evidence, with the limelight of the rising sun full in their faces, save the few high-caste and noble women, who arrive before daylight and are rowed out in curtained boats to bathe and pray unseen in mid-stream. It must require physical courage as well as religious zeal to breast that cold, muddy current on a frosty morning; and, as the majority of these people have only a double cotton sheet for promenade toilet, one shivers sympathetically and wonders at the death rate from pneumonia.

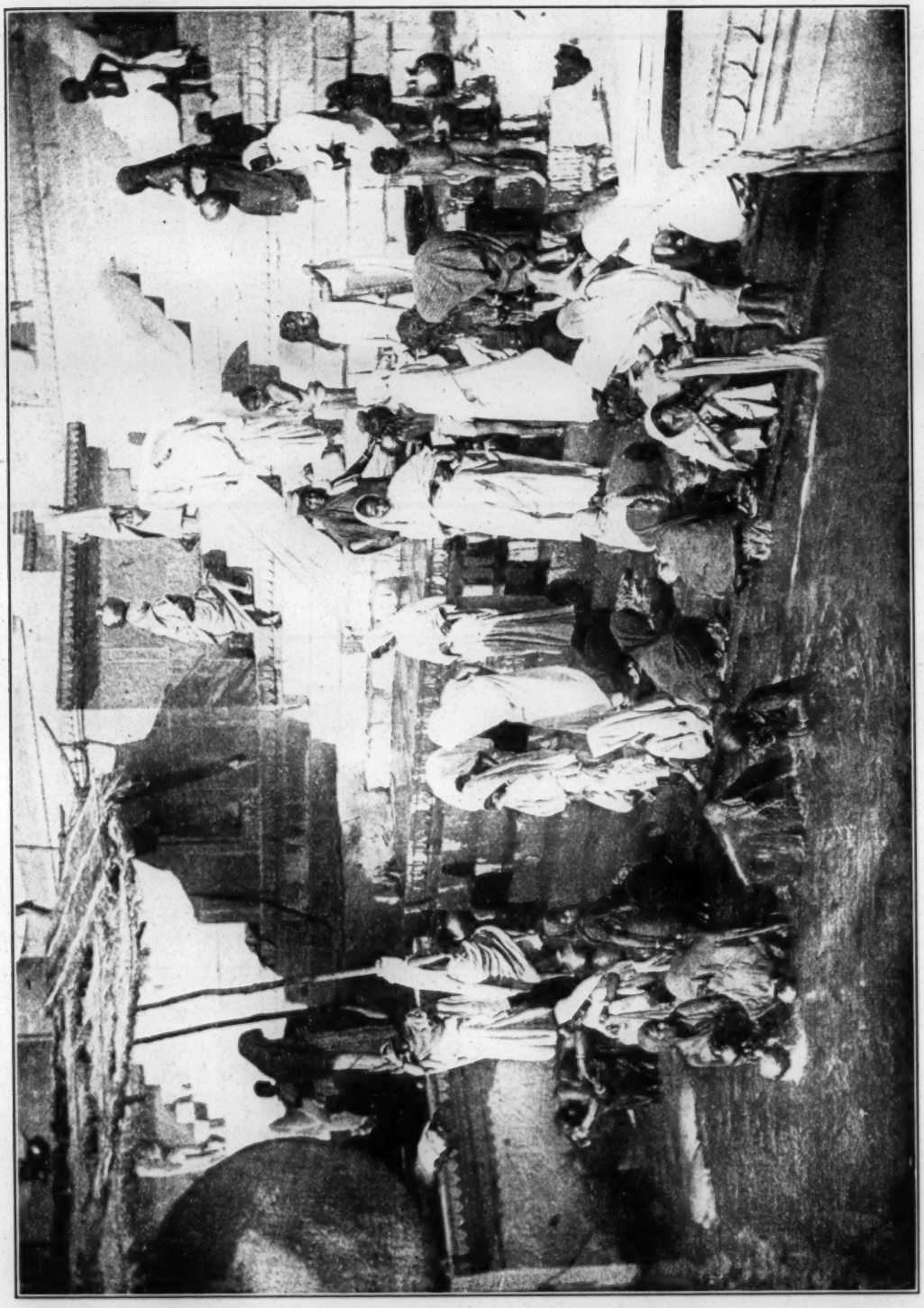
The sun transforms the scene when it conquers the haze and throws clear yellow beams upon the solid and fantastic buildings and the white-robed company. The air mellows, and one basks in the sun thankfully, as do the beggars and fakirs, who shake off their wrappings of mat and sacking, and creep like numb flies to the side of sunny walls. They sit there until some ostentatious Hindu comes along doling out rice to the poor as a means of acquiring merit and favor with the gods—and to be seen of men. These ascetics, grotesque in their powdering of ashes and their rags, touch the sense of humor more than anything else and give one relief in the long-drawn panorama of heathen blindness.

THE WOMAN'S GHAT

The boats are rowed along, close inshore, barely avoiding the most devout ones, who wade farthest out, and all the way there is the same spectacle of religious zeal and spiritual exaltation. At the Woman's Ghat every woman carries a brass lota, or water jar, or a still larger and heavier jar of red pottery, and the unending procession of gracefully-draped figures going up and down the broad ghat is an unending delight. Swathed head and all in their winding *saris*, they wade into the river and pray, one is sure, to every Hindu deity which the ten fingers represent to let them come into the world again in some human form less ignoble than a woman's. They go back to shore and deftly envelop them-

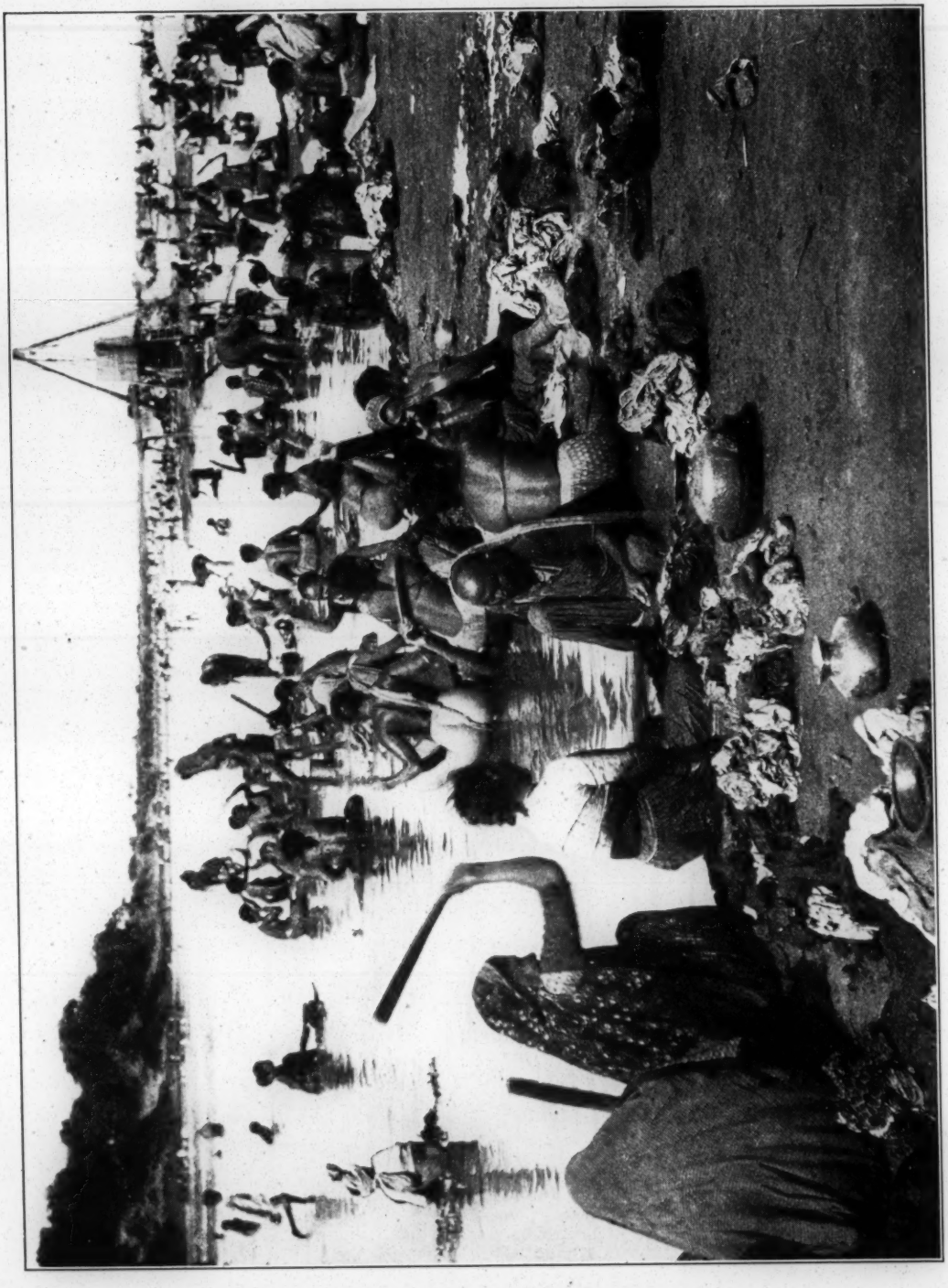


A Bathing Ghat



From "Winter India," by Eliza R. Scidmore, copyright by the Century Co.

The Woman's Ghat at Benares



Dhobie Ghat—the Public Laundry

selves in fresh *saris* and drop the wet ones to the steps without once uncovering the face or exposing more than the feet and hands. They scour their brass lotas with Ganges mud, they wash their hair with sacred muck and fill the jars to take home at the very mouths of the city sewers. The devotees show no fastidious choice in dipping the water they drink. All is Ganges water and all is sacred, even when the surface is afloat with city refuse discharging from the drain pipes at their very elbows. At some sewer mouths the fanatics even seem to stand thickest and sip the sewerage most assiduously, praying to the gods meanwhile to protect them from plague and all diseases. The British government has furnished a model water supply and sanitary sewerage, but the Hindus prefer Ganges filth to municipal drinking fountains, and there is no way to make them do otherwise.

THE BURNING GHAT

The cremation ground is only a waste space of grimy sand and gravel between two stone terraces, a neglected bank gullied by rains, with pyres, building and half-consumed, scattered irregularly, and ghouls poking among the ashes for coins or jewels. More systematic ghouls carry pans of ashes to the water's edge and wash this pay dirt like any placer miner. Alongside this revolting sequel to yesterday's burnings, lie fresh bodies, wrapped in white sheets and garlands of marigolds. The bodies are dipped in the Ganges and laid in rows, with the sacred stream laving their feet and profane ghouls washing pay dirt from yesterday's pyres between and beside them, shaking grime and cinders over the hapless, flower-wreathed bundles.

This rude, open-air crematory is the monopoly of the *domri,* lowest caste of all peoples, who charge extravagantly for their services, for the wood, the oil, and the flame which lights the funeral torch for touching off the pyre. The earlier in the morning the burning occurs, the greater merit and certainty of paradise for the dead one; and the *domri's* charges run from extravagant sums for burning the rich and noble at sunrise, and decrease toward noon and afternoon, when the very poor and the jail criminals are hurriedly burned, or half-burned, for a few annas, and the rubbish and bones shoveled down the bank. Only the highest-caste Brahmin priests and the holy fakirs escape the torch. These exalted beings are supposed to be so holy in life that fire is not needed to purify them. The flower-garlanded fakirs are rowed out to mid-stream and committed to Mother Ganges to carry them down to the sea—if alligators do not first consume them.

As the sun mounts and the air grows golden and softly warm, and the people finish their orisons, the river bank hums and buzzes with the great social exchange. All Benares strolls along the ghats in mid-morning, as all Atlantic City troops to the boardwalk, all Nice to the Promenade des Anglais. Big, flat, palm-leaf umbrellas are tilted against the too warm sun, *saris* and garments are stretched out to dry, and the carrying of water for household use, the washing of pots and clothing and vegetables sets tongues wagging as at any village tank. Belated Brahmins keep on praying and performing their rites and gestures, while their next neighbor on the overhanging platform shampoos his head or brushes his teeth; and the "Sons of the Ganges," a band of robust Brahmins whose specialty is prayer for the repose of the dead, bellow the merits of their particular intercessions above all the din. Then the fakirs wail and shake their ash-smeared heads, hold their shriveled arms the more conspicuously in the ten-year poses of rigidity, and stretch themselves more ostentatiously on the beds of nails. Snake-charmers are there, dancers and jugglers, and everywhere among the noisy crowds the sacred cows push their way, nosing into grain sacks and rice bowls unhindered, and stately Brahmins, painted in geometrical devices of the

highest caste and piety, salaam abjectly to them—a mad world, a crazy crowd, surely.

The throng is densest, the buzz and the bellowing loudest, at the ghat below the cremation ground, for there are the sacred pools filled with Vishnu's perspiration, and where Devi dropped her earring—good reason for sanctity attaching to them, certainly. At this storm center of the holy land of the Ganges bank, the din and the hot sun are dizzying, and the mixture of Ganges water, old flower garlands, milk, butter, oil, sweetmeats, spices, and incense, cast into the tank all day and every day, smells to heaven. The odor is sickening, the sight of the garbage mess more so, and the lepers and hideous sick folk, who crawl up and down the slimy steps, are fit figures in this picture of heathenism triumphant and undisturbed. Hindu intelligence may be measured exactly when one considers that the priests of the river bank could easily check these suicidal celebrants who flock there to drink the putrid mire in hope of cures.

Perhaps it is well that Mrs Annie Besant has established her college at Benares to teach the Hindus their own religion, the purer faith of Vedic times, freed from all the idolatrous and crazy abominations of later days. Nothing could be as bad as the creed that now enslaves them. Poseurs and unbalanced Europeans, who come out to India loudly proclaiming their willingness to labor with Mrs Besant to save the Hindus after this novel plan, return to the world at the end of each cold-weather season. The discipline is strict, the ideals high, the regimen severe at Mrs Besant's college, and even Pierre Loti, after all his sentimentality over the Hindus, could not stand the severe and monkish life prescribed for him by the English prophetess, and returned to the flesh pots of the worldly folk.

The fantastic little Nepalese temple on the river bank is the one living remnant of Buddhism in Benares, where the Buddha preached and taught, and converted the people from Hinduism. It is a dark, dragon-eaved structure with flame-tipped gables, sadly reminding one of Burma and the further east; but the Buddhism obtaining there is far from the simple teachings of the Enlightened One, who lived in the Deep Park out Sarnath way.

Aurangzib's mosque, with its two slender, sky-piercing minarets, is easily the most conspicuous structure along the ghats, as the conqueror intended it should be, and is a galling sight to Hindu eyes. The few Moslems, who can manage to still live in Benares, frequent it every Friday, and the muezzin flings his shrill voice from the minaret as if thousands hung upon his summons; but Hinduism has submerged the faith of the Prophet, as it triumphed over Buddhism centuries before.

THE PUBLIC LAUNDRY

In every river city there are bathing ghats, where the people purify themselves and their garments without the accompaniment of prayer, and there are also ghats by the river bank, or tanks where *dhobees* swing and pound clothes and knead them on boards or stones. The *dhobee* gnats and grounds are always picturesque, and when one sees the energy with which they switch and club the garments entrusted to them, there is no wonder at the way a wardrobe melts away in Indian travel. The corrugated washboard, the clothes-boiler, the labor-saving soap and soda are unknown and their advantages undreamed of, or the Hindu brain would have evolved them thirty centuries ago, when cerebration was more vigorous and all customs were established. The *dhobee* man and his harder-working wife slam and squeeze and hammer now, as they did in the first ages after the loom was invented, and when they have spread their dunnage on dusty turf or handy thorn bush the result is all that could be expected by the wearers of fine linen.

XUM

HOW LONG WILL THE COAL RESERVES OF THE UNITED STATES LAST?*

By Marius R. Campbell

Of the United States Geological Survey

WITH the exception of food and clothing, nothing concerns us so much as fuel. On it we depend for heat and light to make ourselves comfortable, and for power by which to bring within our reach all that goes to make up the material part of our twentieth-century civilization. Today power is the mainspring of human activity; with it modern civilization will flourish—will expand and reach out to the ends of the earth to minister to our pleasures or to satisfy our ambitions; without it so-called civilization will cease to exist and humanity will revert to the condition of primitive man, with brute force as the only dependence for safety and existence.

If, therefore, power is the foundation of all of the material things we consider worth having, is it not well to stop our mad race for a moment and consider whence it comes and how much of the raw material is available for future use?

Without doubt, coal is the only fuel that today is worth considering, and, so far as we can see ahead, it will continue to be the fuel of the future—at least so long as it is within our reach or until other means of power production shall supplant it. Therefore any study of the fuel supply of the future must be based upon a thorough knowledge of coal, its mode of occurrence, amount from which future supplies can be drawn, and rate of consumption, past, present, and to come.

The importance of the subject is shown by the growing value of the coal-mining industry in this country. In the United States in 1905† coal to the amount of 384,598,643 short tons, having a value of $476,756,963, was mined. The value, compared with other mineral products in the same year, is shown by the following table:

TABLE SHOWING VALUES OF MINERAL PRODUCTS OF THE UNITED STATES FOR 1905

(1)	Coal	$476,756,963
(2)	Iron	382,450,000
(3)	Clay products	149,697,188
(4)	Copper	139,795,716
(5)	Oil and gas	125,720,254
(6)	Gold and silver	122,402,683

At the present time the United States is the largest factor in the world's production of coal, as shown by the diagram on page 130.

In the diagram given above the production of the three leading countries is that for the year 1905; of the other countries figures for that year are not available, and the blocks in the diagram represent the production during either the year 1904 or 1903.

THE GROWTH OF COAL

Coal is derived from vegetable material, either as accumulations in swamps from plants growing *in situ* or as wood that has been drifted into basins. In either case the accumulation of vegetable matter has been covered by earthy material washed into the swamp or basin and finally converted into coal. The former hypothesis is more generally accepted than the latter, and it seems to apply to most of the coal beds of this country.

The transformation from vegetable matter into the different grades of coals is a process not well understood, but it seems to consist of the breaking up of hydrocarbons and a partial slow distilla-

*An address to the National Geographic Society, January 22, 1907.

†All statistics of production given in this paper are taken from U. S. Geological Survey, Mineral Resources of the United States for 1905.

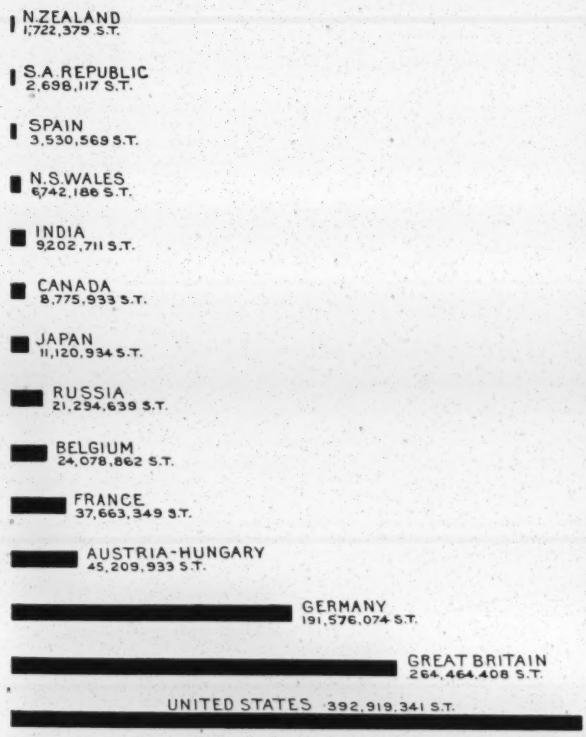


Diagram Showing the Output of the Principal Coal Producing Nations

tion under considerable pressure, but only ordinary temperature. Where the rocks are undisturbed, this is probably an exceedingly slow process, but where the rocks are upturned and broken, the products of distillation find a ready means of escape and the metamorphism may go on at an extremely rapid rate. Naturally the escaping gases are the lightest hydrocarbons, and the material remaining is the heavier, or fixed. carbon.

In a general way, time is an important factor in bringing about this change, and consequently the older carboniferous coals of the east are more highly altered than the younger coals of the west. They are generally converted into bituminous coals, or, in the case of the eastern fields of Pennsylvania and Rhode Island, the intense folding, together with the development of joints and slaty cleavage, has converted the coal into anthracite.

If the coal is cut by dikes or sheets of molten lava, as frequently has been the case, rapid alteration occurs and the coal is converted into coke or anthracite coal. Such cases occur only in fields in which there has been considerable volcanic activity. High-grade coals may be produced in this manner, but generally only a small area is affected, and consequently the results are not of great commercial importance.

The progressive change in composition is shown in the diagram on page 131, which represents the actual chemical composition, as shown by proximate analyses, from the poorest grade of Texas lignite to the best quality of Pennsylvania anthracite.

The increasing value is shown by the relative proportions of fixed carbon (fixed carbon is the carbon remaining after the volatile hydrocarbons have been driven off at a low heat) and the decreasing amount of volatile matter and moisture. In this case the fixed carbon varies from 19 per cent in the lignite to 88 per cent in the anthracite. The volatile matter varies inversely as the fixed carbon, being greatest in the lignite and least in the anthracite. The moisture also diminishes in quantity from the lignite to the anthracite, but the rate is not regular, since much of the moisture is due to the conditions of sampling rather than to the chemical composition of the coal. The ash is variable, depending largely upon the amount of earthy matter that was washed into the old swamp during the growth of the coal-forming plants. The presence of ash is an important factor in the commercial value of a coal, but theoretically it forms no inherent part of the coal and should not be considered.

In a general way, coals may be divided

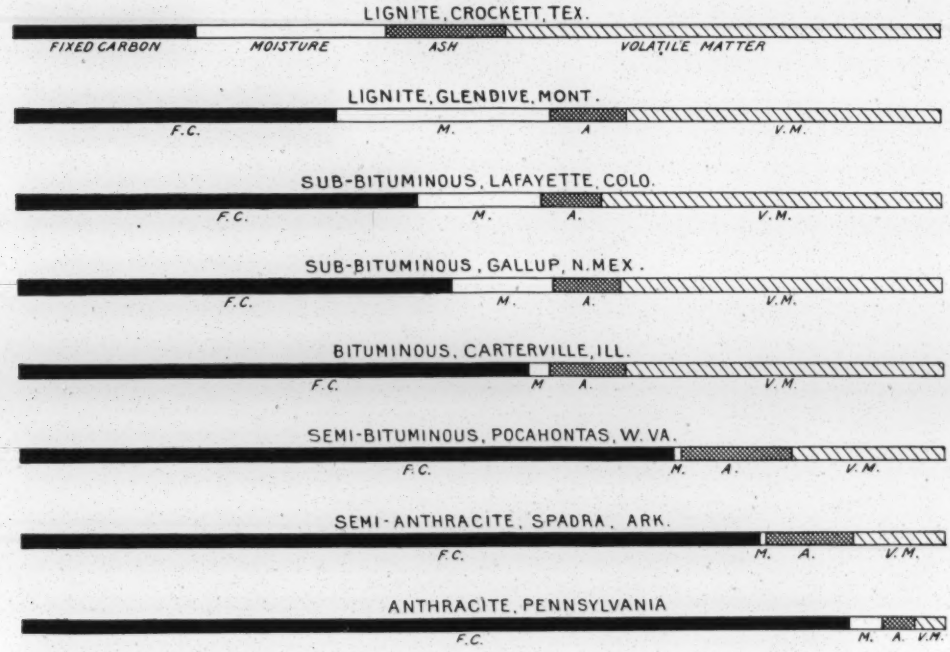


Diagram Showing the Progressive Change in Composition of Lignite, Bituminous and Anthracite

Note that all the moisture and volatile matter has been expelled in the anthracite

into three main classes—anthracite, bituminous, and lignite; but in the trade these main classes are broken up into several groups, which are represented in the following diagram:

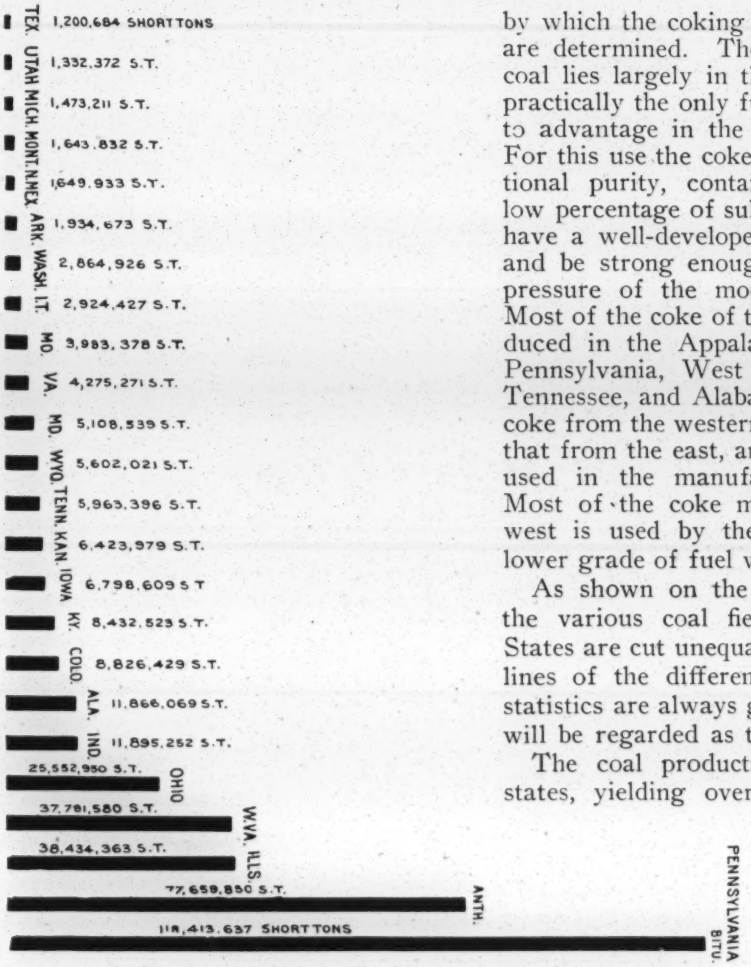
DIAGRAM SHOWING CLASS OF COAL

Coal	Anthracite	(*a*) Anthracite.
		(*b*) Semi-anthracite.
	Bituminous	(*c*) Semi-bituminous.
		(*d*) Bituminous.
		(*e*) Sub-bituminous.
	Lignite	(*f*) Lignite.

(*a*) Anthracite coal is too well known to need description. (*b*) Semi-anthracite is a low grade of anthracite. (*c*) Semi-bituminous is a high grade of bituminous, such as the George's Creek coal of Maryland, Pocahontas coal of Virginia and West Virginia, and the Carboniferous coal of Arkansas. (*d*) Bituminous is the common grade of coal found throughout the eastern coal fields and in limited areas in the west. (*e*) Sub-bituminous is applied to coals below the grade of bituminous, but above that of lignite. They are black and shining, but are light in weight and slack badly on exposure to the atmosphere. These coals are common in the western fields of Washington, eastern part of Montana, northern Wyoming, about Denver in Colorado, and in northwestern New Mexico. (*f*) Lignite is brown and woody, and occurs in North Dakota, South Dakota, Texas, southeastern Arkansas, Mississippi, and Alabama.

THE REASON WHY ONE COAL WILL COKE AND ANOTHER WILL NOT IS NOT UNDERSTOOD

The classes noted above include all of the different kinds of coal that are known, but certain peculiarities of coals within the bituminous class have led to



Coal Output of Principal Coal Producing States

distinctions which are of great importance; thus the property of coking, which is limited entirely to the bituminous class, has given to coals possessing this peculiarity a value far above those coals having similar composition, but which do not possess this characteristic. The reason why one coal will coke and another will not is not understood; apparently it does not depend upon chemical composition, but rather upon some physical property which no one has been able to define. A practical test is the only way by which the coking properties of a coal are determined. The value of a coking coal lies largely in the fact that coke is practically the only fuel that can be used to advantage in the production of iron. For this use the coke has to be of exceptional purity, containing an especially low percentage of sulphur. It also must have a well-developed cellular structure and be strong enough to withstand the pressure of the modern blast furnace. Most of the coke of this character is produced in the Appalachian coal field in Pennsylvania, West Virginia, Virginia, Tennessee, and Alabama. In general the coke from the western fields is inferior to that from the east, and little of it can be used in the manufacture of pig-iron. Most of the coke manufactured in the west is used by the smelters where a lower grade of fuel will suffice.

As shown on the map on page 135, the various coal fields of the United States are cut unequally by the boundary lines of the different states, but, since statistics are always given by states, they will be regarded as the units.

The coal production of the various states, yielding over one million short tons of coal in 1905, is shown in the accompanying diagram.

PENNSYLVANIA PRODUCES THE MOST COAL, BUT MONTANA HAS THE LARGEST COAL FIELDS

As commonly understood, Pennsylvania heads the list with a production which dwarfs that of all other states into insignificance. The other states of the east that occupy prominent positions are Illinois, West Virginia, Ohio, Indiana, and Alabama. Of the western states,

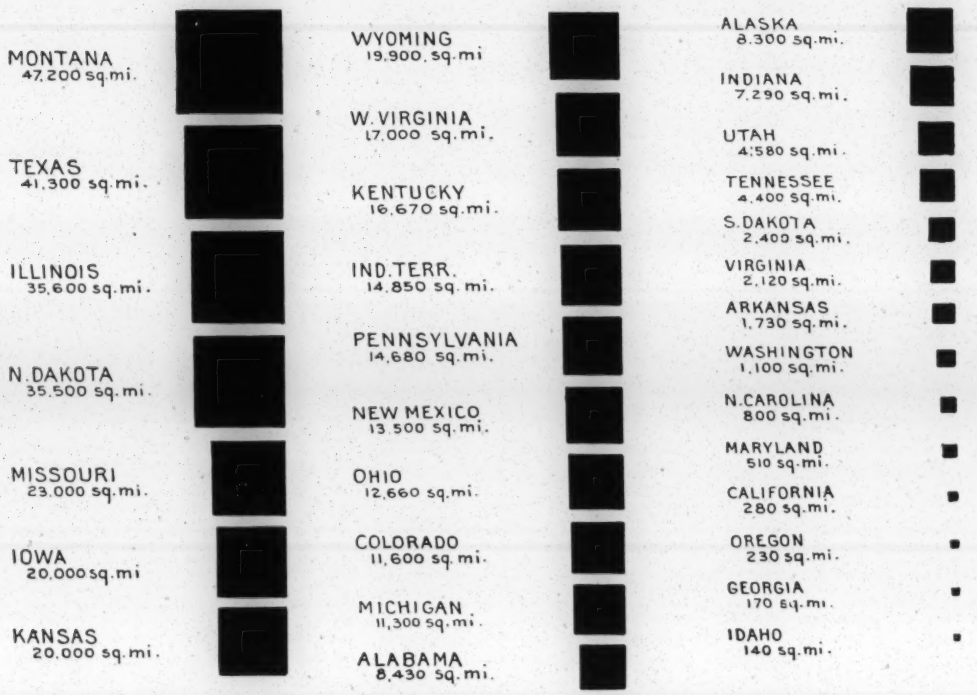


Diagram Showing the Coal Areas of the Various States

Colorado stands at the head, with a production of nearly 9,000,000 tons annually; Wyoming stands second, with a production of 5,600,000 tons; Washington third, with a production of 2,800,000 tons; New Mexico fourth, with 1,600,000 tons; Montana fifth, with 1,600,000 tons, and Utah sixth, with 1,300,000 tons.

The areas of the coal fields that lie within the various states differ greatly, even more than the production. The relative size of these areas is given in the following diagram:

To many readers it will be a surprise to learn that the coal fields of Montana are more extensive than those of any other state, and that Texas is a close second. In this connection it must be understood that each of these states includes an enormous territory, equal to two or three of the smaller eastern states. It is true, however, that most of the coal territory of these states is underlain by low-grade lignite, and hence the fields are not so important as their areas would seem to indicate. The same is true of North Dakota, which includes an extremely large area of coal territory, but unfortunately the fuel is wholly lignite and of comparatively little value.

The extent of some of the coal fields is largely hypothetical. This is particularly the case with Washington, where the present estimate is probably far below the real extent of the fields. It might be supposed that Washington had been explored thoroughly enough to determine approximately the extent of its coal fields, but the peculiar conditions which prevail on the west slope of the Cascade Range make it practically impossible to settle the question at the present time. The surface is deeply covered by glacial drift and vegetation, and it is only where the great streams rushing down off the mountain slopes have cut through this

drift that the coal beds are exposed. In this way they are known at many localities, and it is probable that they are present in the intermediate covered areas, but no one is willing to say so until more prospecting has been done. When that occurs it is probable that the recognized area of the coal fields of Washington will be greatly increased.

The known coal fields of Alaska seem to be comparatively small, having approximately the same area as the bituminous field of Alabama. Here again exploration may, and probably will, increase the area materially, especially that of the low-grade lignites of the Arctic slope.

The area given for the coal fields of Alabama includes only the bituminous coal of Carboniferous age in the northeast part of the state. In addition to this, as shown by the map on page 135, there is a wide band of lignite-bearing Tertiary rocks crossing the southern part of the state. These rocks are known to contain beds of lignite, but in the presence of high-grade bituminous coal the lignite has never been explored, and consequently the number of beds, their thickness and extent, are not known. It is possible that when the supply of better fuel is exhausted, or has fallen below the demand, the lignite field may be found to contain an important supply of fuel.

DISTRIBUTION OF COAL IN THE WEST

The eastern coal fields have been known and worked for so many years that most persons are fairly well acquainted with their extent, the character of the coal, and the number of workable beds. In the western states some of the coal fields are comparatively well known, but many have never been adequately explored, and consequently the information available regarding them is meager. So far as our present knowledge goes, the distribution of the various classes of coal in the western states is as follows:

Anthracite.—Only small areas of anthracite coal have been found in the western states and Alaska. Generally these are the direct result of volcanic activity, and hence are of limited geographical extent.

The largest field of anthracite coal in the western states is in Gunnison County, Colorado, in the Crested Butte region. Apparently the anthracite in this field is the result of immense intrusions of igneous rock, which have baked the coal and thus driven off its volatile matter. The same coal beds only a short distance away are either bituminous or subbituminous in character. One other occurrence of anthracite is known in Colorado, in the Yampa coal field, in the northern part of Routt County. In this locality the coal has been changed to anthracite by dikes and sheets of igneous rock, and the field is very limited in extent.

In New Mexico a small field of anthracite occurs near Cerrillos, on the Santa Fé Railroad. The field is small and the anthracite is due to the baking effect of an intrusive sheet of igneous rock.

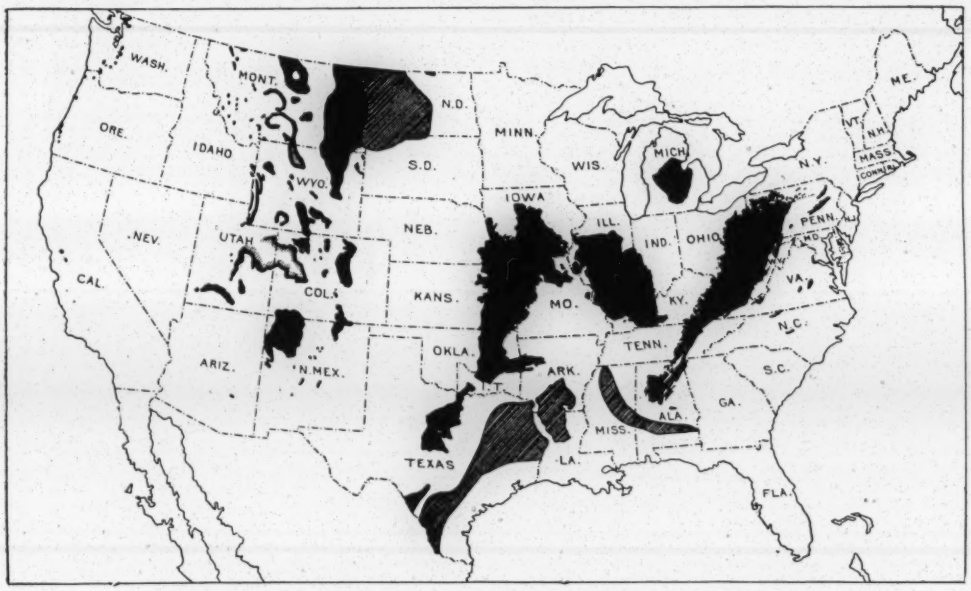
Utah claims a small field of anthracite coal in Iron County, near the southwestern corner of the state. It has not been developed and little is known of its extent or value.

In Washington a very small field of anthracite occurs in the vicinity of a large mass of igneous rock on Carbon River, southeast of Tacoma.

The largest anthracite field outside of Pennsylvania occurs near Controller Bay, in Alaska. In this field the change in the character of the coal is said to be not directly related to volcanic activity, but to be due to the intense folding to which the rocks have been subjected.

At the present time anthracite is mined in the west only in Gunnison County, Colorado, and near Cerrillos, New Mexico.

Coking Coal.—Good coking coal is scarce in the western fields. The principal source of supply is the Raton, or Trinidad, field, in southern Colorado and northern New Mexico. Seventy per cent of the coke produced in the western



Outline Map Showing Coal Areas of the United States

The black areas are anthracite and bituminous; the shaded areas are lignite

fields comes from this region. Some coke is also produced in Colorado, on the west side of the Front Range, at Durango and in the vicinity of Glenwood Springs. Other important centers of coke production are Castle Gate and Sunnyside, in Utah, and along Carbon River southeast of Tacoma, Washington. Coke is also made to a limited extent in Wyoming near the Black Hills and in southern central Montana. There are several other coals that will coke with difficulty, which may be developed in the future, but the present prospect is not particularly promising.

Bituminous, Steam, and Domestic Coal.—This class of fuel is much more abundant than either of the two preceding classes. In New Mexico the largest deposit of such coal is in the Raton field, in the north central part of the territory. Similar coal also occurs in the northern part of the great Durango-Gallup field, in the northwest corner of the territory, and in several small fields south of Santa Fé.

In Colorado good bituminous coal occurs in the fields just mentioned, at Trinidad and about Durango. It is also present in the small field south of Canyon City and in Gunnison County. As shown on the map, the latter field occupies the southeastern point of a large synclinal basin which extends as far west as Castle Gate, Utah. The coal outcrops on the south limb of this basin in the Book Cliffs west of Grand Junction and along the "Great Hogback" from Gunnison County northwestward through Glenwood Springs and Meeker. Throughout the whole line of outcrop around this basin the coals are of the bituminous class, although in places they belong to the lowest group of the class. Good bituminous coal also abounds in the Yampa field, in Routt County. Thus it will be seen that Colorado has a large supply of this class of coal.

Utah is also well supplied by the same basin and by its extension southward from Castle Gate along the Wasatch Plateau. There is also a small field at

Coalville, east of Salt Lake City, and a field of unknown extent in Iron County, occupying the Colob Plateau.

Wyoming has bituminous coals along the line of the Union Pacific Railroad at or near Hanna, Rawlins, Rock Springs, and Kemmerer, and also in small areas about the Black Hills. It is possible that other areas of bituminous coal exist in this state, but they are not well known.

Montana has considerable bituminous coal in the fields along the Northern Pacific Railroad west of Billings, about Great Falls, and in the Crazy Mountains, but by far the largest areas in the state carry coal of an inferior grade.

Washington has several bituminous coal fields along the western foothills of the Cascade Mountains and at least one local basin at Roslyn, on the eastern side.

Most of the coals of California are of low grade, but one bed has been developed in Stone Canyon, in the southeast corner of Monterey County, that is good bituminous coal. So far as known, this is the only coal of this class in the state.

Sub-bituminous Coal.—This class of coal is abundant in the western fields. Most of the coal in the south part of the Durango-Gallup basin is of this class. It is the only coal found in the Denver basin and in North and South Parks of Colorado. The great fields in the northeastern part of Wyoming, the Bighorn basin, and most of the fields in Uinta County contain sub-bituminous coal. All of eastern Montana is supposed to be underlain by it, as is also the big field in the north-central part of the state around the Bearpaw Mountains. A number of small fields lying west of Butte, Helena, and the main Front Range contain coal of this character, but generally they are of small extent and probably have little commercial value. In Washington this class of coal is abundant, but as a rule it occurs some distance west of the Cascade Mountains.

Lignite.—This class of fuel is found only in the fields of southern Alabama, Mississippi, Arkansas, and Texas on the Gulf slope and North and South Dakota at the north. It is mined commercially only in North Dakota and Texas.

THE COAL FIELDS BELONGING TO THE GOVERNMENT ARE MOSTLY LIGNITE

Up to the present time we have used our fuel without a question as to the possibility of its exhaustion, for if such a thought has entered the mind it has been dismissed with the optimistic remark that "the American people are ingenious and inventive, and when the coal becomes exhausted some other source of heating power will be discovered." Such assurance is delightful, but it will not suffice to keep us warm, nor to turn our mills and keep trains running when our coal supply is gone.

Of late, however, the more far-seeing people have been thinking deeply on this subject, especially since the recent order of the President withdrawing temporarily from coal entry 64,000,000 acres of coal land, and his recommendation to Congress that the time has arrived to begin the conservation of our mineral fuels, and urging upon that body the passage of laws upon the subject.

In the older fields of the east, with the exception of Indian Territory, practically all of the coal land has passed to private ownership. Therefore the present order and the interest of the people generally centers about the coal fields of the Rocky Mountain region and the Pacific slope. The former contains an area estimated at 134,800 square miles, and the latter, including Alaska, 10,000 square miles, or a total of 144,800 square miles out of a total for the whole country of 400,500 square miles.

Of this area of 144,800 square miles of coal fields of the western states, it is estimated that 50 per cent has passed to private ownership, leaving about 72,000 square miles of coal fields yet belonging to the government. It must be remembered, however, that more than half of this area is included in the lignite fields of eastern Montana, North Dakota, and South Dakota, and when this is deducted from the figures given above it leaves an

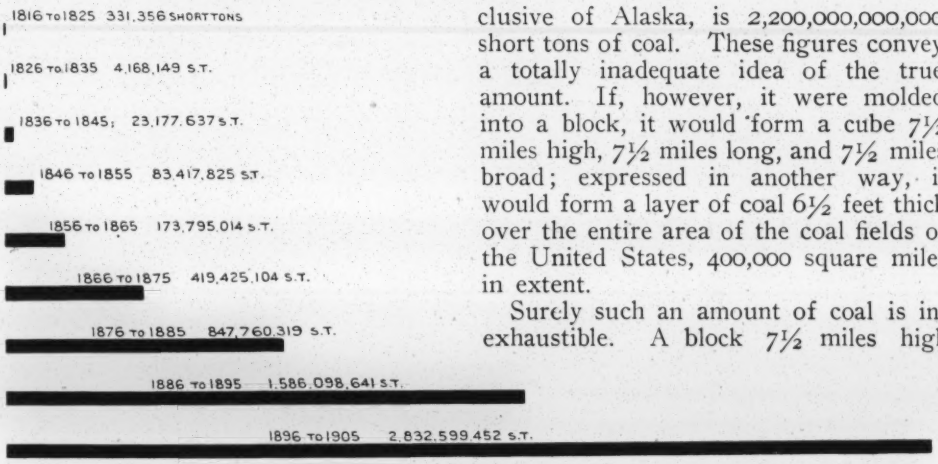


Diagram Showing the Increasing Rate of Consumption of Coal in the United States

area of only about 33,000 square miles of fairly good coal, the title to which is still vested in the United States.

Have we an inexhaustible supply of coal, as many would have us believe, or should we begin to husband our resources? Is the government justified in withdrawing all coal from sale, as proposed in the recent message of the President to Congress? The answer to these questions depends largely upon the broad problem of what is the extent of our coal supply, how rapidly are we using it, and is there a possibility that our stock of fuel will be exhausted in the near future?

In order to answer these questions, the writer has attempted to estimate the amount of coal yet remaining in the coal fields of the country. Such an estimate must necessarily be vague and unsatisfactory for the reason that our knowledge of the coal fields is limited, but recent reconnaissance surveys have been made over the most important coal fields of the west, and now it is possible to make an estimate of their approximate contents.

THE ESTIMATED AMOUNT OF COAL IN THE UNITED STATES FIELDS

According to this estimate, the total tonnage of coal in the United States, exclusive of Alaska, is 2,200,000,000,000 short tons of coal. These figures convey a totally inadequate idea of the true amount. If, however, it were molded into a block, it would form a cube 7½ miles high, 7½ miles long, and 7½ miles broad; expressed in another way, it would form a layer of coal 6½ feet thick over the entire area of the coal fields of the United States, 400,000 square miles in extent.

Surely such an amount of coal is inexhaustible. A block 7½ miles high would tower above the highest mountains on the earth. Is it possible that the people of this country can use such a mass of coal? Before the question is answered we must determine the rate of coal consumption and study the factors of which it is composed to see if they are liable to fluctuate greatly in the near future. The following diagram, prepared from statistics of coal production collected by Mr E. W. Parker, of the United States Geological Survey, shows graphically the amount of coal produced in each decade since 1816.

WILL OUR COAL LAST 100 YEARS?

The actual consumption of coal in the United States during this period has been somewhat greater than that shown by the diagram, for some coal has been imported, but the diagram shows the rate at which we have been using our own coal. The rate of increase is enormous; it is simply appalling. As shown by the diagram, the amount produced in any one decade is equal to the entire previous production. The curve indicating the increase seems to be going off into the future in a straight line, and this means an increased production that no supply, however great, can withstand for many years.

If the rate of consumption of 1905 were maintained indefinitely, without change, our coal would last approximately 4,000 years, but if the constantly increasing rate which has marked the consumption during the past 90 years be maintained, our coal will practically be exhausted within 100 years.

The question now remains, Will this increasing rate hold? In order to answer that question we must analyze the present consumption to see whether all of the factors composing it will probably continue to increase in the future as they have done in the past.

A large part of the coal produced in this country is consumed by the railroads. According to an estimate prepared by the Interstate Commerce Commission, the amount of coal consumed by locomotives in 1905 amounted to 106,000,000 tons. Will this increase or decrease in the future? While it is possible that railroad building in the future will not be so active as it has been in the past, there is every prospect of a great and growing increase in the traffic of existing lines, and this will lead to a constantly increasing consumption of coal unless some new source of power is discovered. The same argument applies to steamship lines, to manufacturing, and to domestic consumption of coal. In view of these considerations, it does not seem probable that the rate of increased consumption will be affected materially for a great many years to come, and hence the estimate of 100 years will be nearer the truth than 4,000 years. The real life of our coal fields probably will be somewhere between these extremes, and it seems probable that it may be about 200 years.

If this estimate is even approximately correct, is it not time for the government to take some steps to prevent the remaining coal of the west from passing to the hands of corporations, to prevent wasteful methods of mining and use, and to conserve for the use of the common people even this small fraction of the total coal of the country? No doubt there is a great difference of opinion on this subject, but it is hard to see how any fair-minded person interested in the good of the people of this country rather than the corporations can look upon the present situation with other than concern, and can fail to unite in an effort to avert the evil consequences that may be in store for future generations.

EFFORTS TO OBTAIN GREATER ENERGY FROM COAL

REALIZING the rapidity with which our coals are being consumed, the government several years ago established in connection with the United States Geological Survey a coal-testing plant to ascertain (1) means by which more energy can be obtained from coal, and (2) whether some of the coals and lignites previously considered of little value cannot be utilized. The waste of the energy of coal in the ordinary steam boiler is tremendous, it being calculated that only from 5 to 7 per cent of the energy is secured. The remaining 93 to 95 per cent is lost, owing principally to wasteful and imperfect methods of combustion. Prof. Joseph A. Holmes summarizes the work thus far done as follows:

In connection with the work of the United States Geological Survey fuel-testing plant at St Louis, where a large number of coals from very nearly every state containing coal has been tested, some important results have been developed which would tend toward conserving the coal supply. The most important of these results show that the

vast brown and black lignite deposits of the West are available for use in the gas-producer. It has been demonstrated that brown lignite from North Dakota will produce in some cases more than four times the power when used in the gas-producer than when burned under the boiler. These lignites, containing from 20 to 45 per cent moisture, have always stood at the bottom of the scale as a boiler fuel, and they have been used for power purposes only where it has been impossible to secure bituminous coal. It was discovered at the Geological Survey coal-testing plant that these lignites, in spite of their high moisture content, can be utilized commercially to the best advantage in the gas-producer equipment.

In the boiler-room of the fuel-testing plant, where careful study has been made of combustion and the conditions governing the methods of firing the various coals of the United States, it has been shown that through proper stoking and superintendence the coal bill of the country could be considerably reduced by this careful attention to details which is too often neglected in the average commercial plant.

A force of specially trained experts has been at work for some time making a careful study of coals which contain too much ash or sulphur to be available for commercial purposes. These investigations have been carried on both in the laboratory and in the field, and the results obtained so far look forward to a time when these dirty coals can be greatly improved by proper washing or other means of mechanical preparation, and as a result many low-grade coals will be extensively operated.

The briquetting of slack coal and other waste sizes has been successfully accomplished at a low cost. The resultant briquettes have proved superior, in almost all cases, to lump coal from the same mines for power purposes. This branch of the investigations opens to the commercial world a hitherto unknown field which is destined soon to become an important factor in the production of fuel.

The following tabular statement shows the comparative efficiencies of a number of coals tested in the gas-producer and burned under boilers, demonstrating the economy of the gas-producer equipment:

Table showing the relative efficiency of coals used under the steam boiler and in the producer-gas plant at the U. S. Geological Survey fuel-testing plant, St. Louis, Mo., in 1904 and 1905.

(By Marius R. Campbell.)

No.	Name of coal tested.	Steam.	Ratio.	Producer gas (one electrical horse-power per hour equals 1,000).
1	West Virginia (13)	0.287	3.34	0.961
2	West Virginia (14)	.276	3.29	.909
3	West Virginia (18)	.275	3.03	.883
4	Virginia (3)	.279	2.60	.826
5	Ohio (5)	.246	3.23	.794
6	Pennsylvania (5)	.273	2.86	.781
7	Pennsylvania (8)	.285	2.74	.781
8	Ohio (6)	.249	3.10	.770
9	Virginia (4)	.265	2.88	.763
10	West Virginia (20)	.281	2.71	.763
11	Pennsylvania (10)	.278	2.72	.758
12	West Virginia (4)	.269	2.82	.758
13	Kentucky (6)	.270	2.79	.752
14	Ohio (4)	.246	3.04	.746
15	Pennsylvania (6)	.256	2.85	.730
16	Virginia (2)	.262	2.77	.725
17	Illinois (19)	.223	3.22	.719
18	Kentucky (5)	.279	2.59	.719
19	West Virginia (16)			.714
20	Kentucky (1)	.262	2.71	.709
21	Pennsylvania (4)	.272	2.59	.704
22	West Virginia (9)	.279	2.51	.701
23	Ohio (9)	.242	2.89	.700
24	West Virginia (7)	.274	2.43	.667
25	Ohio (3)	.234	2.83	.662
26	West Virginia (12)	.278	2.35	.654
27	Virginia (1)	.271	2.41	.653
28	Ohio (8)	.236	2.69	.641
29	Indian Territory (4)	.202	3.15	.637
30	Illinois (10)	.190	3.31	.629
31	West Virginia (1)	.251	2.42	.625
32	Indiana (8)	.214	2.90	.621
33	Indiana (7)	.212	2.86	.606
34	Kentucky (7)	.224	2.71	.606
35	Ohio (7)	.238	2.51	.599
36	Pennsylvania (7)	.256	2.32	.599
37	Kansas (5)	.243	2.44	.592
38	Alabama (2)	.233	2.51	.585
39	Indiana (11)	.227	2.55	.578
40	Illinois (13)	.227	2.53	.575
41	Illinois (18)	.212	2.71	.575
42	Illinois (14)	.187	2.99	.559
43	Illinois (15)	.206	2.70	.556
44	Illinois (16)	.236	2.34	.553
45	West Virginia (8)	.261	2.10	.549
46	Indiana (5)	.209	2.61	.546
47	Indiana (9)	.212	2.56	.543
48	Illinois (11)	.196	2.67	.523
49	Indian Territory (1)	.229	2.28	.521
50	Illinois (3)	.211	2.45	.518
51	Indiana (6)	.207	2.49	.515
52	Indiana (3)	.203	2.50	.508
53	Illinois (8)	.157	3.22	.505
54	Illinois (9)	.171	2.91	.498
55	Illinois (6)	.159	3.11	.495
56	Illinois (4)	.181	2.71	.491
57	Wyoming (3)	.174	2.82	.490
58	Kentucky (3)	.218	2.24	.488

One of the most important lines of investigation being conducted by the experts of the fuel-testing plant is the study of coal mines throughout the country to determine, where certain portions of the bed are being discarded, if it is not possible to utilize the discarded portion for power or other purposes. At the present time gas-producer tests are being made on "bone" coal containing from 45 per cent of ash upward. So far no difficulty has been encountered in running the producer plant on this material. This "bone' coal has always been looked upon by the miners as a waste product, and is being mined and discarded in many localities, notably the Hocking Valley region in Ohio.

The old dumps are available as well as the "bone" which is in place in the mines, and should the experiments now being conducted at the fuel-testing plant prove entirely successful, there should be a market for this material.

POLAR PHOTOGRAPHY

By Anthony Fiala

Leader of the Ziegler Polar Expedition, 1903–1905, and Author of "Fighting the Polar Ice"

THE sun shines day and night through the short Arctic summer, revolving like the hour hand of a great clock in the dome of the sky not far above the circle of the horizon. With the blazing luminary and the vast white stretches of snow and ice, there ought to be no lack of light—a veritable paradise for the photographer.

At first sight it would seem that with all this dazzling brilliancy over-exposure would be the evil to guard against, and that comparatively small openings and quick speeds would be the rule for lenses and shutters. But no! Though the Arctic explorer may travel in danger of snow-blindness in a flood of light, direct and reflected, he soon finds that the actinic value of sunlight is less than in lower latitudes—in fact, surprisingly little—and he is obliged to use his very quickest lenses, and then with their widest openings use the slowest speed consistent with the movement of the men and animals which he photographs on the crystal fields.

On my first Arctic expedition I took color screens, but only used them or tried to use them a few times. I soon found that, instead of giving color and character to the views, they flattened and deadened the pictures of ice and snow and lengthened the exposure to hopelessly long intervals of time. The reason for this is the low altitude of the sun and the consequent high refraction, which gives more of the yellow and red rays than of the blues, as is the case with an evening sun in our own latitude.

With so much reflected light, the pictures would suffer for want of shadows, and I soon found that to get good values in ice pictures it was necessary to photograph with the sun in such a position that the long shadows cast between the ice blocks by the low orb could be used to accentuate the high lights and give character and contrast. To that end, it was necessary to have the sun either at the right or left hand, and often I exposed a film pointing the lens directly at the sun.

The artist who attempts to photograph the ice-fields after the time-honored custom of always having the sun behind his back will generally be doomed to flat, insipid negatives and almost meaningless pictures unless he can find shadows enough in the foreground to give character to the view.

In regard to apparatus and material, around the ship and hut any good camera can be used. I had several sizes. On the first expedition I took a number of glass plates, but was unfortunate enough to break some of my best negatives, so when I went into the field again I took nothing but films. On the sledge journeys, where the question of weight is of great consequence, the lightest form of camera is sure to be the favorite. In my last trip over the moving polar pack I found that a kodak was about the most convenient, and took with me a panoram kodak (which weighed with its leather case only four and a half pounds) and a small supply of films in water-tight tin tubes.

On a sledge journey the camera and films were always kept in the outer air, usually in a compartment of the canoe that was lashed to one of the sledges. During low temperatures, the interior of a tent is not the place in which to load a camera. The little difference in temperature between the air of the shelter and of the outside is sufficient to cause condensation of moisture and the cold lenses and metal work of the instrument coat with a film of ice. Often, as I stood with my back to the sun in an endeavor to shade the camera as much as possible, with a temperature of from 30 to 40° below zero, I have struggled with the little catches of the kodak and have had my fingers stick to the cold metal of the tin tubes containing the films while taking out an exposed roll and reloading the camera with a new one. Care had also to be exercised to keep the instrument from being frosted by the vapor from hands and body. It was always with a feeling of thankfulness and relief that the camera was made ready and I could slip my half-frozen hands into mittens and by swinging the arms and performing a sort of Indian war dance restore circulation. On return to camp the films were all developed in an improvised dark-room with a small alcohol lamp to keep the developer at about 60 degrees temperature. I believe the new tank developer would be just the thing for explorers and particularly good for developing films exposed in the Arctic, where long development is absolutely necessary to insure good results. Part of the outfit comprised a bioscope, a form of moving-picture camera, with which I hoped to secure views of men, dogs, and ponies moving over the ice-fields, the advance of the *America* through the ice, and, if possible, a bear fight. Of all my photographic apparatus, the bioscope gave me the most trouble, particularly in the low temperatures of spring and early autumn. The long celluloid film upon which the numerous little negatives were made (twenty to a second) became very brittle under the influence of the extreme cold, and would fly to pieces when the mechanism of the instrument was started, and pieces of celluloid would clog the gear wheels and jam between moving parts. After many failures, I hit upon the plan of warming the machine and wrapping it up in hot blankets just before taking a picture. The heating and wrapping up was done in the hut at camp. I was thus enabled to secure some valuable films; a few of them reached a length of 300 feet. But always, as soon as the instrument became cold, the films broke like fragile glass. It was impossible to warm the bioscope on the trail, so I was limited to views near the ship and in the vicinity of camp.

We shot a number of bears for food. A bear fighting for his life, surrounded by a biting, snarling pack of dogs, would have been a splendid subject for a motion-picture camera; but I was never so fortunate as to have camera and fight at the same time.

The pictures which show the ponies and dogs hauling their loaded sledges over the ice bring back in vivid reality the cold, white fields and the struggling men and animals fighting their way over the frozen wastes.

The explorer with a camera has gone over very nearly all the earth and has brought back as part of his record views of life and land in the far-off parts of the earth.

There is still land to be conquered; and it is good to know that when these unknown places are found and the flags of discovery are planted, that with the help of the sun and modern chemistry, we will all be able to view with the explorer what had once been forbidden and mysterious territory.

NOTES ON THE FOREST SERVICE

THE Forest Service of the United States has under its control today property which exceeds in value all the forts, the arsenals, the warships, and the navy-yards controlled by the War and Navy Departments combined. The number of forest reserves in various parts of the country, but mainly in the far West, is over 100, and the number is being continually increased. The present area of these reserves is over 125,000,000 acres, an area equal to that of all the north Atlantic and middle Atlantic states as far south as Virginia. The approximate value of the present forest reserves may be estimated as follows:

Stumpage value of 330 billion feet of timber at $2 per 1000	$660,000,000
110 million acres, capable of producing commercial forest, at $1 per acre	110,000,000
110 million acres of range for grazing live stock, at 1½ cents per acre (capitalized at 5 per cent)	30,000,000
83 million acre-feet of water for irrigation purposes, at 10 cents per acre-foot (capitalized at 5 per cent)	166,000,000
Three million horse-power-capable of being developed from water in reserves, at $10 per horse-power (capitalized at 5 per cent)	600,000,000
Estimated value of occupancy and use of reserve land, products and resources additional to the above	5,000,000
Permanent improvements now on the reserves (roads, trails, cabins, telephones, etc.)	5,000,000
Total	$1,576,000,000
Less 10 per cent for private holdings	157,600,000
	$1,418,400,000

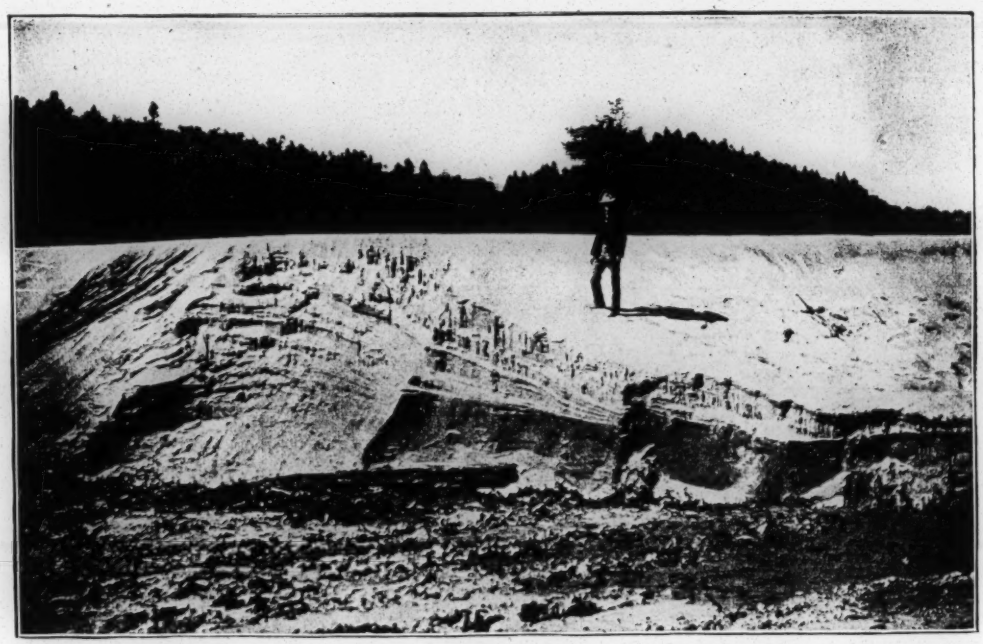
NEED OF FOREST RESERVES IN THE EAST

But while the far West is literally dotted with forest reserves, the East has almost no reserves. There is, however, now pending in Congress a bill, already passed by the Senate, which would create a White Mountain forest reserve in the State of New Hampshire, to comprise approximately 812,000 acres. There are, of course, no public lands in New Hampshire, and therefore the national government must buy the land from private owners. The national government must buy it because the benefit which will accrue from the reservation will be not alone for New Hampshire, but for all the New England states, save possibly Rhode Island. Elaborate arguments were made last spring before the Agricultural Committee of the House of Representatives, which has this bill in charge. The bill provides for an appropriation of $3,000,000 for the White Mountain reserve, and also for a larger reserve in the Appalachian Mountains, in the southern states. At the hearings before the committee it was abundantly proved that the creation of these reserves, and that without further delay, is a matter of the highest importance to the respective sections in which they are located. The injurious effect upon the Connecticut River of the destruction of the White Mountain forests was so amply testified to as to be beyond question.

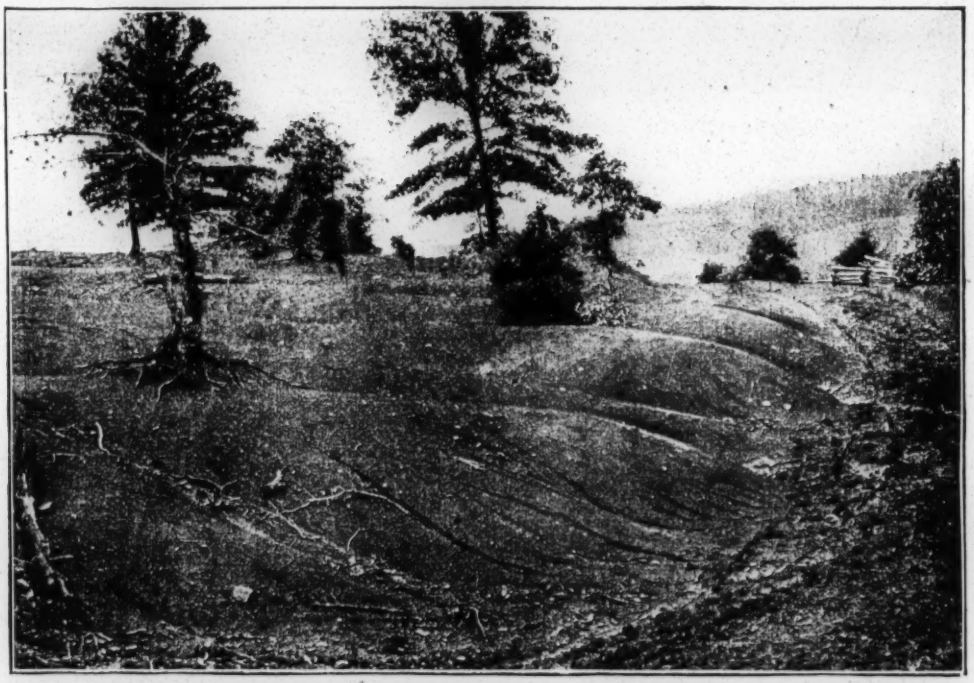
PLAN TO MAKE THE FOREST RESERVES SELF-SUPPORTING*

The money value of the national forests now reserved for the use and benefit

* Extract from a recent message to Congress by President Roosevelt.



Sand Spreading Over Fertile Soil, Catawba River Lowlands



Appalachian Mountain Field Completely Ruined by Erosion

Both pictures show the frequent results of reckless destruction of the forests

Cypress and Eucalyptus Lining An Irrigating Ditch, Forming a Windbreak, Southern California

of the people exceeds considerably the sum of one thousand million dollars. But this vast domain is withheld from serving the nation as freely and fully as it might by the lack of capital to develop it. The yearly running expenses are met by the annual appropriation and the proceeds of the forests. Under the care of the Forest Service the latter are increasing at the rate of more than half a million dollars a year. The estimate of the appropriation for the present year is less than that for last year, and *it is confidently expected that by 1910 the Forest Service will be entirely self-supporting.* In the meantime there is the most urgent need for trails, fences, cabins for the rangers, bridges, telephone lines, and the other items of equipment without which the reserves cannot be protected properly and cannot contribute as they should to the general welfare. Expenditures for such permanent improvements are properly chargeable to capital account. The lack of reasonable working equipment weakens the protection of the national forests and greatly limits their production. This want cannot be supplied from the appropriation for running expenses. The need is urgent. Accordingly I recommend that the Secretary of the Treasury be authorized to advance to the Forest Service, upon the security of the standing timber, an amount, say $5,000,000, sufficient to provide a reasonable working capital for the national forests, to bear interest and to be repaid in annual installments beginning in ten years.

WOLVES

THE enormous losses suffered by stockmen on the western cattle ranges and the destruction of game on forest reserves, game reserves, and in the national parks through the depredations of wolves have led to special investigations by the Biological Survey, in coöperation with the Forest Service, to ascertain the best methods for destroying these pests. The results appear in a report by Mr Vernon Bailey, of the Biological Survey, which includes also field notes on the distribution, abundance, and breeding habits of wolves. (Forest Service Bulletin 72.)

The chief object of the report is to put into the hands of every hunter, trapper, forest ranger, and ranchman directions for trapping, poisoning, and hunting wolves and finding the dens of young.

The wolves of North America are divided into two groups—the smaller coyotes, or prairie wolves, of the western United States, Mexico, and southwestern Canada, comprising several species and subspecies; and the larger gray, black, or timber wolves, distributed practically throughout the whole of North America from Florida and the table-land of Mexico to the Arctic Ocean. These large wolves—commonly called "loafers" or "lobos"—include at least half a dozen species or geographic races, comprising the small dark gray or black wolf of Florida and the southeastern United States, the red wolf of southern Texas, the brindled wolf of Mexico, the light-gray wolf of the Central Plains region, the dark-gray wolf of eastern Canada, the almost white wolf of northern Canada and Alaska, and the large black or dusky wolf of the Northwest Coast region. Their habits differ mainly in adaptation to the varied conditions of their environment—timber, plains, mountains, deserts, or northern barren grounds —and in the methods of pursuit and capture of different kinds of animals for food.

Wolves still occupy most of their original range, except where crowded out of the more thickly settled regions. The large gray wolf of the plains and middle west is at present the most abundant

Persian Cats in Hamadan

From "Persia Past and Present." By A.V.Williams Jackson. Copyright by The Macmillan Co.

Photo by Vernon Bailey, U. S. Bureau of Biological Survey

Nine Wolf Pups in Front of Their Den

XUM

species in the United States and the most destructive to stock. Over the thinly settled ranch country of Montana, the western parts of the Dakotas and Nebraska, and of Wyoming, Colorado, New Mexico, and western Texas, where stock-raising is the principal industry, the wolves have held their own, and in favorable sections have increased since the destruction of their former prey, the buffalo, and the introduction of still greater numbers of domestic cattle—this, too, in the face of a fierce warfare waged by ranchmen, trappers, and hunters.

GEOGRAPHIC LITERATURE

Climatology of the United States. By A. J. Henry. Bull. Q., U. S. Weather Bureau. 4to., pp. 1012. Washington, D. C.: Government Printing Office. 1906.

This is probably the most important publication ever issued by the Weather Bureau, inasmuch as it comprises an exhaustive summary of the meteorological data down to date, collected by the Signal Service and the Weather Bureau.

The first 84 pages are devoted to a discussion of the climates of the country, element by element—atmospheric pressure, storms, winds, temperatures, precipitation, humidity, and cloudiness. This part of the work is profusely illustrated with maps and diagrams.

The body of the book is composed of meteorological statistics of 690 Weather Bureau stations, distributed over the country as uniformly as practicable. Each station is fully described, with position, elevation, history, and equipment. The data given for each station are as follows, as fully as possible: For each month, each season, and the year, the normal temperature, the mean of the maxima and the absolute maximum temperatures, the mean of the minima and the absolute minimum temperatures, and the highest and lowest monthly mean temperatures; the normal precipitation, the number of days with more than a trace of precipitation, the total amount in the dryest and wettest years, the average depth of snow, and the greatest depth in 24 hours, the mean relative and absolute humidity and amount of sunshine, and finally the direction of the prevalent wind; then follow dates of temperature extremes.

The stations are arranged geographically by states, and those of each state are preceded by a physical description of the state and a summary of the climatic data.

Students of American climate will find this work invaluable. It is to be hoped that every other country having a meteorological service will prepare a similar work. H. G.

The Wonders of the Colorado Desert. By George Wharton James. 2 vols., 8vo., pp. 44+547. Illustrated. Boston: Little, Brown & Co. 1906. $5.00.

This sumptuous book describes a region which for the past two years has been very much in the public eye, for it is that also known as the Salton Desert, into which the Colorado River is pouring its waters and re-creating a lake in its midst. The story is here told at length, with an account of the numerous attempts made to close the gap in the natural levee and restore the river to its former channel; but this forms but a small part of the book. The aspect of the desert, its strange vegetable and animal inhabitants, its mountains and sand dunes, its delights and dangers, its history, are all described by one who feels the call of the desert and has the skill to picture it. With these descriptions are intercalated legends of lost mines, tragedies, narratives of journeys, and among the latter a boat trip down the outflow from the Colorado to the Salton Lake—a strange trip in a strange region.

The book is beautifully and lavishly illustrated, in part by half-tones from photographs by the author and in part by sketches from the pencil of Mr Carl Eytel. The map is by no means, in point of execution, on a par with the rest of the work. H. G.

Romantic Cities of Provence. By Mona Caird. Pp. 413. 6½ by 9 inches. Illustrated. New York: Imported by Charles Scribner's Sons. 1906. $3.75 *net.*

The author tells in a delightfully personal way of a journey through the south of France, that wonder country of the ancients, where the ruins of an amphitheater, arch, or massive bridge erected during the Roman occupation, about 40 B. C., is regarded as being quite modern. The writer gives a vast amount of historical information, with anecdote and legends of the birth of chivalry and its offspring, the Troubadours, who ruled France with their music. The volume is enriched throughout with many splendid sketches of Provence, Arles, Avignon, Beaucaire, and Nimes by Joseph Pennell and Edward Synge. Much attention is given to the architecture of the ancients as well as that of the Renaissance, and it is quite evident that the volume is not written as a text-book, but rather for those who have at least a passing acquaintance with Provence and its brilliant history. J. O. L.

The Heart of England. By Edward Thomas. Pp. 360. 8 by 10½ inches. Illustrated. New York: E. P. Dutton & Co. 1906. $6.00 *net.*

The author, having made a study of the quaint old customs of England, tells of them in a pleasing way. Throughout the shires of England many customs and habits have been handed down from father to son through centuries. These have been collected from many

out-of-the-way places, and the volume will be welcomed by those who love the old traditions and folklore, which are fast being lost to view amid the progress and hurry of today. A number of old English ballads are given, many of which have not been before published in our generation. The author has quite caught the real atmosphere of rural England, and a number of beautiful colored illustrations by H. L. Richardson add in a great measure to the attractiveness of the volume. J. O. L.

Geography of Nebraska. By George Everet Condra. Pp. 192. 5 by 7½ inches. Lincoln, Nebraska: University Publishing Co. 1906.

This little geography has been written for the school children of Nebraska, and contains chapters on the formation of the soil and rock beds of Nebraska, on atmospheric conditions, illustrated with weather charts, and on the methods of reclamation—irrigation, forestation, and dry-farming—practiced in the state. The text is illustrated with pictures, maps, and charts, and is well indexed. It is an admirable publication.

Touraine. By Anne MacDonald. Illustrated. Pp. 420. 8 by 10½ inches. New York: E. P. Dutton & Co. 1906. $6.00 *net.*

There has been much written of the south of France, with its fascinating history, but there seems to be always something new to be learned. In this volume the writer brings out of the past a wealth of legend and folklore of this ancient land of great rivers and valleys, of chateaux and marches, giving to each its song and story. The author has sought to set forth the warlike achievements as well as the untutored diplomacy of the feudal kings and rulers of this wonder country, telling in a masterly way of innumerable invasions, of heroic defense and unceasing strife, from the time of its occupation by the Celtic-Puroni, whom Cæsar's legions found there, through the dark centuries, when the fair country was given over to the ravages of Goth and Franc, of Musselman and Gaul, until the dawn of the Renaissance overspread the land. The work is magnificently illustrated by A. B. Atkinson with two-score artistic pictures in color, as well as many drawings, showing the marvelous architecture of each century, which is perpetuated in towered chateaux and cathedral, in grim fortress and shrine. The work is complete and shows the heights which the publisher's art has reached. J. O. L.

A Cruise Across Europe. By Donald Maxwell. 8vo., pp. 254. Illustrated. New York and London: John Lane. 1907.

A delightful narrative of a sail in a small boat up the Rhine, across to the Danube, by an old, disused canal, and the journey down the Danube to the Black Sea. Most of the route is remote from the track of the tourist, and the travelers, two young Englishmen, have many novel adventures. H. G.

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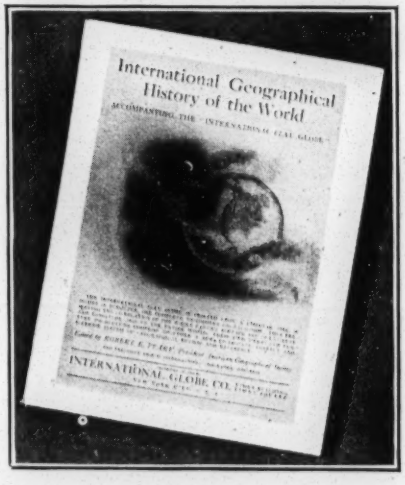

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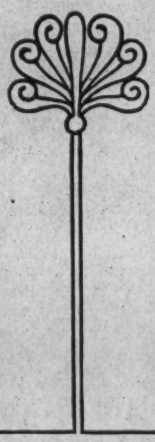

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